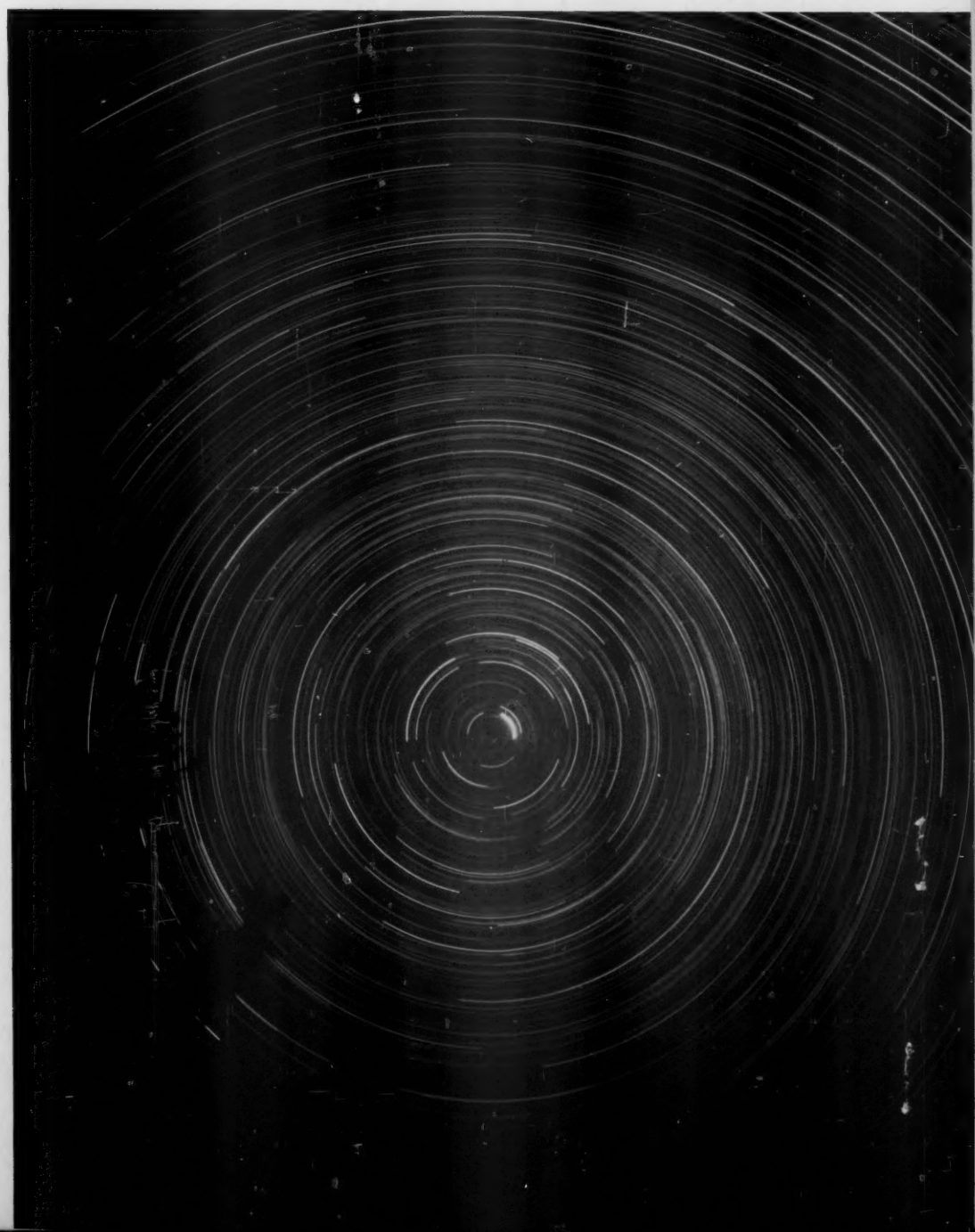
JAN 30 1961

SCIENCE

27 January 1961

Vol. 133, No. 3448

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



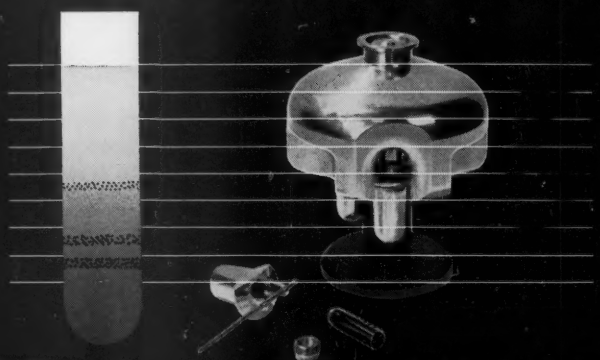
Preparative Ultracentrifugation gives the ultimate in fractionation according to size, density, or both

Density gradient (or zone) centrifugation is a rapidly developing major technique for achieving separations by centrifugal means.

The method has many uses for separation, identification and quantitation. It is ideal for analyzing cytoplasmic homogenates ...individual components from a mixture can be separated for chemical or biological assay...materials of identical size but differing slightly in density, or those of similar density but differing slightly in size, are readily distinguished and isolated.

The powerful technique of

DENSITY GRADIENT CENTRIFUGATION



STABILIZING DENSITY GRADIENTS
Gradients can be formed either before centrifugation begins, by layering solutions of different concentrations of a substance such as sucrose—or they can be formed during centrifugation by the redistribution of a material like cesium chloride under the influence of centrifugal force.

Rate Separations—In this density gradient method, particles migrate from the top of the tube at different rates depending on their size, shape and density. Slight differences in density can be exaggerated by changing the density of the solution in the centrifuge tube.

Equilibrium Separations—In this method, particles seek their own density levels in the tube and attain equilibrium positions which are dependent upon density alone. Resolving power in separating materials is dependent upon the magnitude of the density gradient.

The standard equipment for doing density gradient work is the Model L Preparative Ultracentrifuge (left) and SW-39 Swinging Bucket Rotor (above). The rotor operates at speeds to 39,000 rpm, generating 173,000 g at the outer tube edge.

Let the Model L with its outstanding ability to speed through jobs—both routine and exotic—start working for you now. Write for full technical information including: a description of the instrument; an applications chart showing types of materials which can be run (with rotors, times, speeds and references); a new paper summarizing density gradient techniques and how to use them.

Address: Beckman Instruments, Inc., Spinco Division, Stanford Industrial Park, Palo Alto, California, and ask for Data File L-5.

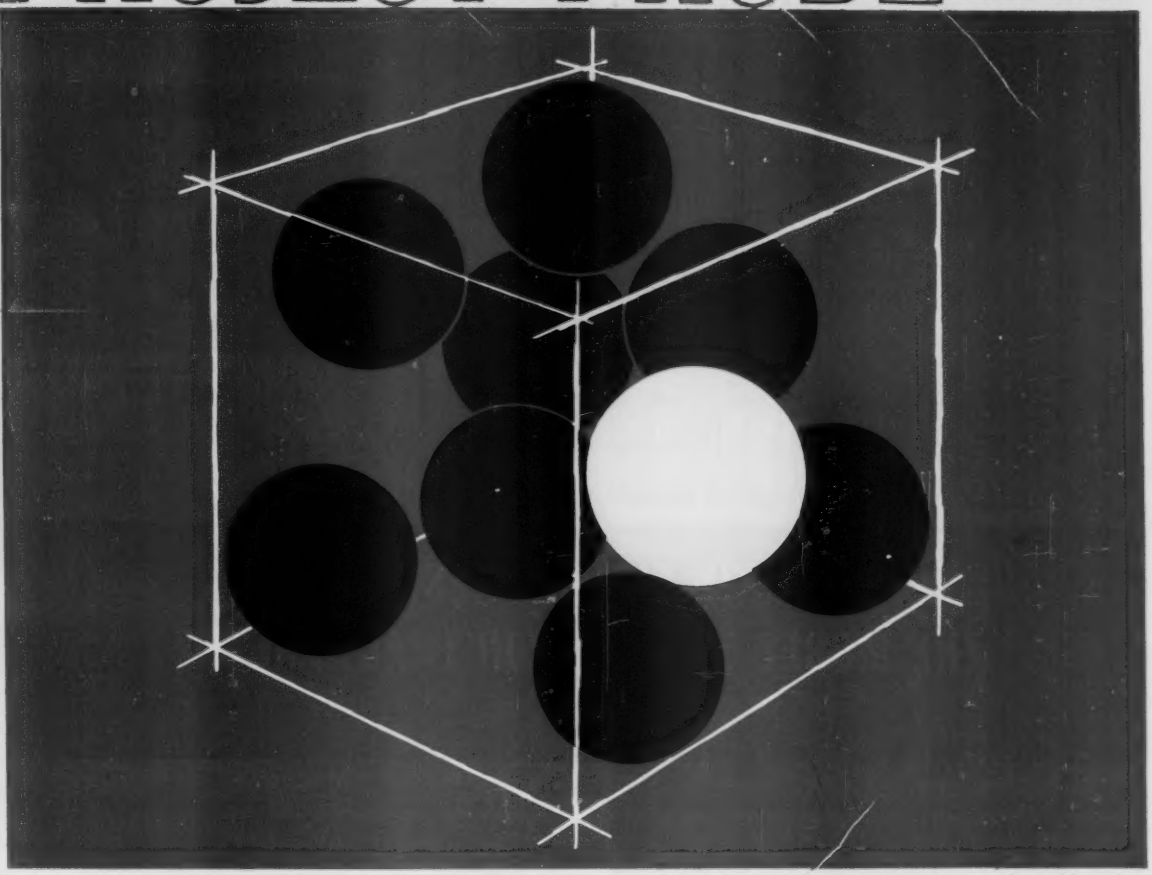
Beckman® / **Spinco Division**
Beckman Instruments, Inc.

S-66A

SALES AND SERVICE FACILITIES ARE MAINTAINED BY BECKMAN/INTERNATIONAL DIVISION IN FIFTY COUNTRIES

MELPAR LAUNCHES: PROJECT PROBE

The Parade of Disciplines in the Most Advanced Areas of the ***Physical Sciences***



Today, exploring in all of the physical sciences, Melpar is probing in many areas of fundamental research, such as:

Physical Chemistry, encompassing the relation of physical properties of biological materials to biological functions.

Physical Techniques and Measurements in such fields as electron spin resonance, in conjunction with the studies of molecular structure to determine Zeeman effects on free radicals.

Chemistry Studies in fluorescence, organic reactions, electrochemistry, polymer research, and gas chromatography and radiochemistry.

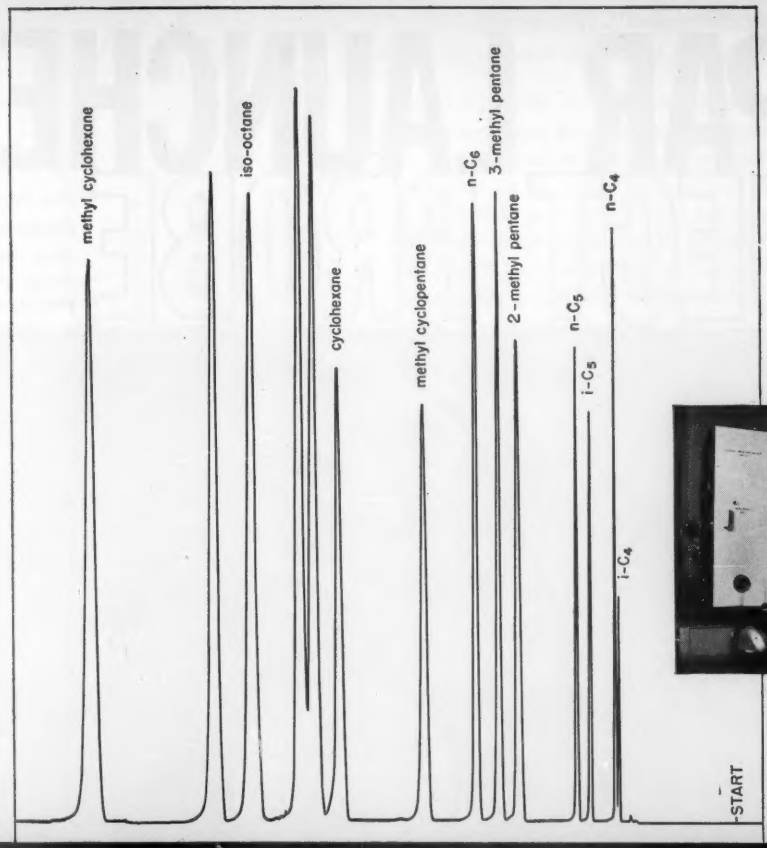
Why use gas chromatography? Why use electron spin resonance? These represent but a few of the areas Melpar is now exploring. This is Melpar: Project Probe.

Scientists with advanced degrees in any of the Physical Sciences, who are interested in participating in **Melpar: Project Probe,** are invited to write to F. J. Drummond, Professional Placement Manager, Melpar, 3354 Arlington Boulevard, Falls Church, Virginia.

MELPAR INC

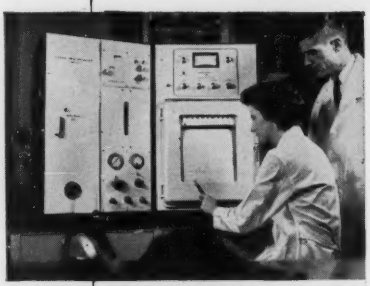
A Subsidiary of Westinghouse Air Brake Company

SCIENCE is published weekly by the AAAS, 1515 Massachusetts Ave., NW, Washington 5, D.C. Second-class postage paid at Washington, D.C., and additional mailing office. Annual subscriptions: $8.50; foreign postage, $1.50; Canadian postage, 75¢.



This chromatogram was run on a Model 154-D Vapor Fractometer, utilizing a 150′ propylene glycol ("R") Golay* column. Detector was of the flame ionization type. The chromatogram displays high-efficiency separation of a number of C_4-C_6 saturated hydrocarbons.

*Patent No. 2,920,478



The Perkin-Elmer Model 154-D Vapor Fractometer.

PERKIN-ELMER PRESENTS THE MODEL 154-D VAPOR FRACTOMETER

... a totally new concept in analytical versatility

Although a relatively young science, gas chromatography has advanced with giant strides since its introduction in 1952. And Perkin-Elmer, designer and producer of the first commercial gas chromatograph, keeps pace with its progress with the new Model 154-D Vapor Fractometer.

This latest member of the famous 154 series of Perkin-Elmer gas chromatographs combines, in one versatile unit, the latest advances in instrumentation: Golay (capillary) columns, ionization detectors, precise micro-sampling techniques. To match the increased performance demands of these revolutionary new developments, new and more rugged components have been introduced in critical areas of the Model 154-D. Added to the superlative regular features of the 154 line, these provide, in one instrument, the utmost in analytical versatility, reliability and precision.

Versatility: The outstanding attribute of the new Perkin-Elmer Model 154-D is its exceptional analytical *versatility*. Precise, reproducible sampling of gas and liquid micro- and macro-quantities and specialized "micro-pilot-plant" accessories provide complete sample introduction capability. For partition analysis, the Vapor Fractometer may be operated in any one of the following modes:

1. **standard packed columns with thermal conductivity detection;**
2. **Golay columns with ionization gauge detection;**
3. **standard packed columns with ionization gauge detection; and**
4. **in parallel operation, using packed columns-thermal conductivity detection, and Golay columns-ionization gauge detection.**

For these varied modes of operation, a complete selection of column designs and stationary phases is available to meet any sample situation. Four detectors are offered as standard accessories, providing a choice to handle specific analytical needs.

Complete details on the Model 154-D Vapor Fractometer are provided in a new brochure. Send today for your copy to: Perkin-Elmer Corporation, 910 Main Avenue, Norwalk, Connecticut.

Ask about our instrument leasing program

INSTRUMENT DIVISION

Perkin-Elmer *Corporation*

NORWALK, CONNECTICUT

27 January 1961, Volume 133, Number 3448

SCIENCE

Editorial

Advising the President on Manpower 253

Articles

The Moral Un-Neutrality of Science:
C. P. Snow with remarks by *W. Weaver, T. M. Hesburgh,* and *W. O. Baker* 255

The scientist's special responsibilities are examined in an address given at the 1960 AAAS annual meeting.

Science in the News

Inauguration Week: Ike's Farewell Address; Reorganizing the Atomic Energy Commission; Rules Committee Maneuvers 263

Book Reviews

Thought Reform of the Chinese Intellectuals and *The Hundred Flowers Campaign and the Chinese Intellectuals,* reviewed by *Lindsay of Birker;* other reviews 269

Reports

Role of Enzyme Induction in Embryonic Development: *M. Spiegel* and *D. L. Frankel* .. 275

Differential Thermograms of Polysaccharides: *G. Chesters* and *S. O. Thompson* 275

Ticks from European-Asiatic Birds Migrating through Egypt into Africa:
H. Hoogstraal and *M. N. Kaiser* 277

Electrophoretic Analysis of Young Alligator Serum:
E. F. Baril, J. L. Palmer, A. H. Bartel 278

Alteration of Plasma Proteins at Metamorphosis in the Lamprey (*Petromyzon marinus dosatus*): *D. P. Rall, P. Schwab, C. G. Zubrod* 279

Test of Response Bias Explanation of Word-Frequency Effect:
C. R. Brown and *H. Rubenstein* 280

Relation between the Inorganic Chemistry and Biochemistry of Bone Mineralization:
D. McConnell, W. J. Frajola, D. W. Deamer 281

Relations between Whitefly and Sweetpotato Tissue in Transmission of Yellow Dwarf Virus: *E. M. Hildebrand* 282

Chemical Nature of Antheridogen-A, a Specific Inducer of the Male Sex Organ in Certain Fern Species: *R. B. Pringle* 284

Maintenance of Avoidance Behavior under Temporally Defined Contingencies:
H. M. B. Hurwitz and *J. R. Millenson* 284

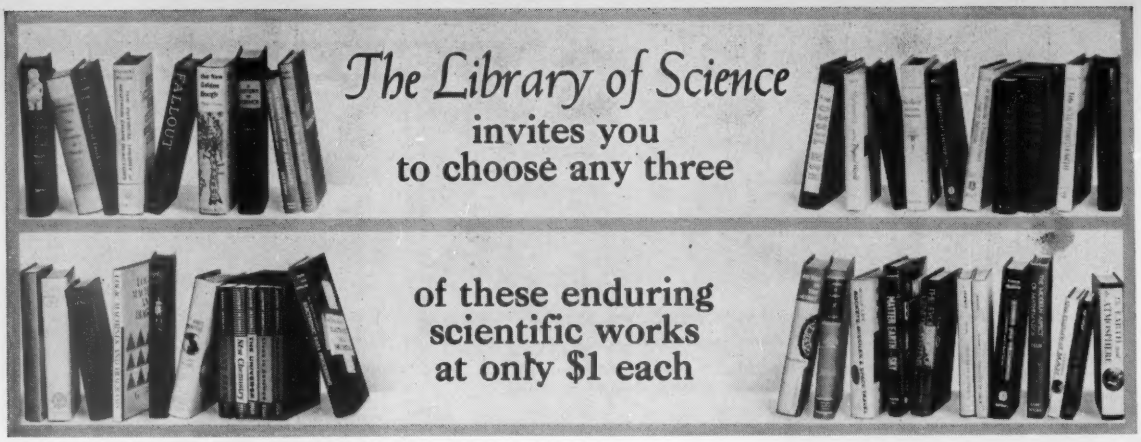
Departments

Letters from *D. Park; D. F. Peterson; J. P. Hailman* 251

Forthcoming Events; New Products 286

Cover

Circumpolar star trail study showing Polaris circling about 1 degree from the true Pole and showing 2000 stars, 42 of which can be seen by the eye (exposure time, 4 hours). From *Outer Space Photography for the Amateur* by Henry E. Paul; see page 271. [Amphoto, New York]



An expanding world of knowledge, presented by leading scientific discoverers and thinkers
—37 fine volumes currently available to members

MATHEMATICS AND PLAUSIBLE REASONING. 2 vols. *by* George Polya—*Induction and Analogy In Mathematics* and *Patterns of Plausible Inference.* List Price $9.00

PROBABILITY THEORY AND ITS APPLICATIONS, *by* William Feller. List Price $10.75

LOGIC MACHINES AND DIAGRAMS, *by* Martin Gardner. List Price $5.00

ELECTRONS, WAVES AND MESSAGES, *by* John R. Pierce. List Price $5.00

ELECTRONIC DATA PROCESSING, *by* Roger Nett *and* Stanley A. Hetzler. List Price $6.75

SPACE BIOLOGY, *by* James S. Hanrahan and David Bushnell. The human factors in space flight. List Price $6.00

THE LOGIC OF SCIENTIFIC DISCOVERY, *by* Karl R. Popper. List Price $7.50

MATHEMATICS AND THE PHYSICAL WORLD, *by* Morris Kline. List Price $6.00

HARLOW SHAPLEY: SOURCE BOOK IN ASTRONOMY. From 1900 to the fifties—with 62 illustrations. List Price $10.00

FOSSIL MEN, *by* Marcellin Boule *and* Henri V. Vallois. List Price $9.50

PETER B. MEDAWAR: THE FUTURE OF MAN *and* **THE UNIQUENESS OF THE INDIVIDUAL,** two volumes by the 1960 Nobel Prize Winner. List Price $7.00

MATTER, EARTH AND SKY, *by* George Gamow. List Price $10.00

MATHEMATICS DICTIONARY, *by* Glenn *and* Robert C. James. Definitions of over 7,000 mathematical terms, concepts and relationships, with 423 integral tables, over 400 mathematical symbols, differentiation formulas, and a 72-page four-language index of basic terms. List Price $15.00

EVOLUTION OF GENETIC SYSTEMS, *by* C. D. Darlington. List Price $5.50

PRINCIPLES OF GEOCHEMISTRY, *by* Brian Mason. Second edition, newly revised and enlarged. List Price $8.50

GEORGE SARTON'S second volume of **A History of Science.** List Price $11.00

SIR JAMES G. FRAZER'S *NEW* GOLDEN BOUGH. One-volume abridgment, *ed. by* Theodor H. Gaster. List Price $8.50

STRANGE WORLD OF THE MOON, *by* V. A. Firsoff. List Price $6.00

A STUDY OF THINKING, *by* Jerome S. Bruner. List Price $6.00

RIVERS IN THE DESERT, *by* Nelson Glueck. Archeological explorations in the Negev. List Price $6.50

GAMES AND DECISIONS: An Introduction to Game Theory, *by* R. Duncan Luce *and* Howard Raiffa. List Price $8.75

THEORIES OF LEARNING, *by* Ernest A. Hilgard. List Price $5.50

THE TREE OF CULTURE, *by* Ralph Linton. List Price $7.50

PHYSICAL THEORY OF NEUTRON CHAIN REACTORS, *by* Alvin M. Weinberg *and* E. P. Wigner. "First authoritative and unified account of modern reactor theory." *Robert A. Charpie.* List Price $15.00

SIGMUND FREUD: The Interpretation of Dreams. The only complete English translation. List Price $7.50

CHARLES DARWIN: Life and Letters. Two volumes, boxed, *edited by* his son, Francis Darwin. List Price $10.00

THIS SCULPTURED EARTH, *by* John A. Shimer. Geological forces and landscape, 105 illustrations. List Price $7.50

FALLOUT: a study of superbombs, strontium 90 and survival, *ed. by* J. M. Fowler. List Price $5.50

WORDS AND THINGS, *by* Roger Brown. The psychology of language and the nature of meaning. List Price $6.75

CONCEPTS OF SPACE *and* **CONCEPTS OF FORCE.** Two volumes *by* Max Jammer. List Price $9.25

W. E. LE GROS CLARK: THE ANTECEDENTS OF MAN. The modern classic, wholly revised, on the evolution of the primates. List Price $6.00

MODERN ASPECT OF MATHEMATICS, *by* Lucienne Felix. The Bourbaki revolution in mathematics. List Price $5.00

SCIENTIFIC AMERICAN BOOKS, Second Series. Five paperbound volumes, boxed, by the editors of the *Scientific American.* List Price $7.25

WILLY LEY: Rockets, Missiles and Space Travel. 3rd revised edition. List Price $6.75

THEORIES OF THE UNIVERSE, *by* Milton K. Munitz. From primitive myth to modern astronomy, physics and mathematics. List Price $6.50

A SHORT HISTORY OF SCIENTIFIC IDEAS, *by* Chas. Singer. List Price $8.00

TACTICS OF SCIENTIFIC RESEARCH, *by* Murray Sidman. List Price $7.50

Up to $41.00 worth of books for only $3.00

The Library of Science, Dept. L-84
59 FOURTH AVENUE, NEW YORK 3, N. Y.

Please enroll me as a member and send me at once the three Selections indicated below, for which you will bill me only $3.00 (plus postage). As a member, I need take as few as four more Selections during the next 12 months, from the more than 75 works available to me at reduced Member's Prices. I understand that I will receive a free bonus book of my own choosing after every four Selections.

SELECTIONS_____

_____

_____

NAME_____

ADDRESS_____

CITY_____ ZONE____ STATE_____

FOR THE SERIOUS, the important and the enduring in scientific literature, readers interested in keeping up with contemporary developments have turned in increasing numbers to The Library of Science. Now in its fifth year, The Library of Science counts as members over 50,000 scientists, educators and related professionals.

The 37 works listed here exemplify the depth, scope and quality of the volumes offered each month at substantial savings to members of The Library of Science. From archeology to zoology, from the behavior of the electron to the functioning of the living cell, from the inner structure of the earth to the limitless reaches of space—Library of Science Selections range over the entire universe of scientific knowledge.

To start your membership, choose any three of these fine books *at only $1.00 each.* Thereafter, as a member, you need take as few as four more Selections during the next 12 months from the more than 75 available to you at reduced Member's Prices. These, together with the free Bonus Books which you yourself choose after every fourth Selection, insure you savings that total over 40%.

The Library of Science, 59 FOURTH AVENUE, NEW YORK 3, N. Y.

NEW! A DOG FOOD DEVELOPED ESPECIALLY FOR LABORATORY USE!

Not just another dog food, ROCKLAND DOG DIET is the first dog diet scientifically compounded to meet the exacting requirements of biological research.

Balanced to meet the demands of pre-conditioning, post-operative and convalescing stress. Formulated of components carefully selected to provide uniform high quality, palatability, known composition, and a minimum of variation in nutrient content. ROCKLAND DOG DIET provides an adequate dietary regimen of constant and known origin. Built-in palatability helps eliminate wide fluctuations in feed intake or complete inanition. No need to supplement. Feeds dry to save time, effort, money.

See your Rockland Dealer and discover how ROCKLAND DOG DIET can help contribute to laboratory consistency and efficiency.

other ROCKLAND standard reference stock diets:

ROCKLAND RAT DIET (complete) • ROCKLAND MOUSE DIET • ROCKLAND RAT DIET ("D"-Free)
ROCKLAND MONKEY DIET • ROCKLAND RABBIT RATION • ROCKLAND GUINEA PIG DIET

ROCKLAND™ DIETS

Products of
A. E. STALEY MFG. COMPANY • DECATUR, ILLINOIS

A report to the members of AAAS

AAAS SYMPOSIUM VOLUMES

published during 1959 and 1960

No.		Retail	Members*
65	**Aging . . . Some Social and Biological Aspects** Nathan V. Shock, Ed. Nov. 1960 436 pp., 65 illus., index	$ 8.50	$ 7.50
64	**Calcification in Biological Systems** R. F. Sognnaes, Ed. July 1960 526 pp., 283 illus., 1 color page, index	9.75	8.50
63	**Congenital Heart Disease** A. D. Bass and G. K. Moe, Eds. June 1960 372 pp., 147 figures, index	7.50	6.50
62	**Water and Agriculture** Roy D. Hockensmith, Ed. June 1960 206 pp., 21 illus., index	5.00	4.50
61	**Biological and Chemical Control of Plant and Animal Pests** L. P. Reitz, Ed. Apr. 1960 286 pp., 11 illus., index	5.75	5.00
60	**Epidemiology of Mental Disorder** B. Pasamanick, Ed. Dec. 1959 336 pp., 6 illus., index	6.50	5.75
59	**Low-Level Irradiation** Austin M. Brues, Ed. Dec. 1959 158 pp., 18 illus., index	3.75	3.25
58	**Rehabilitation of the Mentally Ill** M. Greenblatt and B. Simon, Eds. Dec. 1959 260 pp., 3 illus., index	5.00	4.50
57	**Systems of Units—National and International Aspects** C. F. Kayan, Ed. Dec. 1959 308 pp., index	6.75	5.75
56	**Symposium on Basic Research** Dael Wolfle, Ed. Oct. 1959 328 pp., summary	3.00	2.50
55	**Photoperiodism and Related Phenomena in Plants and Animals** Robert B. Withrow, Ed. Oct. 1959 921 pp., 256 illus., genera and species index, subject index	14.75	12.50
54	**The Human Integument—Normal and Abnormal** Stephen Rothman, Ed. July 1959 270 pp., 59 illus., index	6.75	5.75
53	**Grasslands** Howard B. Sprague, Ed. June 1959 424 pp., 37 illus., index	9.00	8.00
52	**Evolution of Nervous Control from Primitive Organisms to Man** A. D. Bass., Ed. June 1959 240 pp., 61 illus., index	5.75	5.00
51	**Zoogeography** C. L. Hubbs, Ed. Jan. 1959 520 pp., 115 illus., author index, index of scientific names	12.00	10.50

British agents: Bailey Bros. & Swinfen. Ltd., Hyde House, W. Central St., London, W.C.1

* Members' prices are for orders submitted together with payment by AAAS members.

To: AAAS,

1515 Massachusetts Ave., NW, Washington 5, D.C.

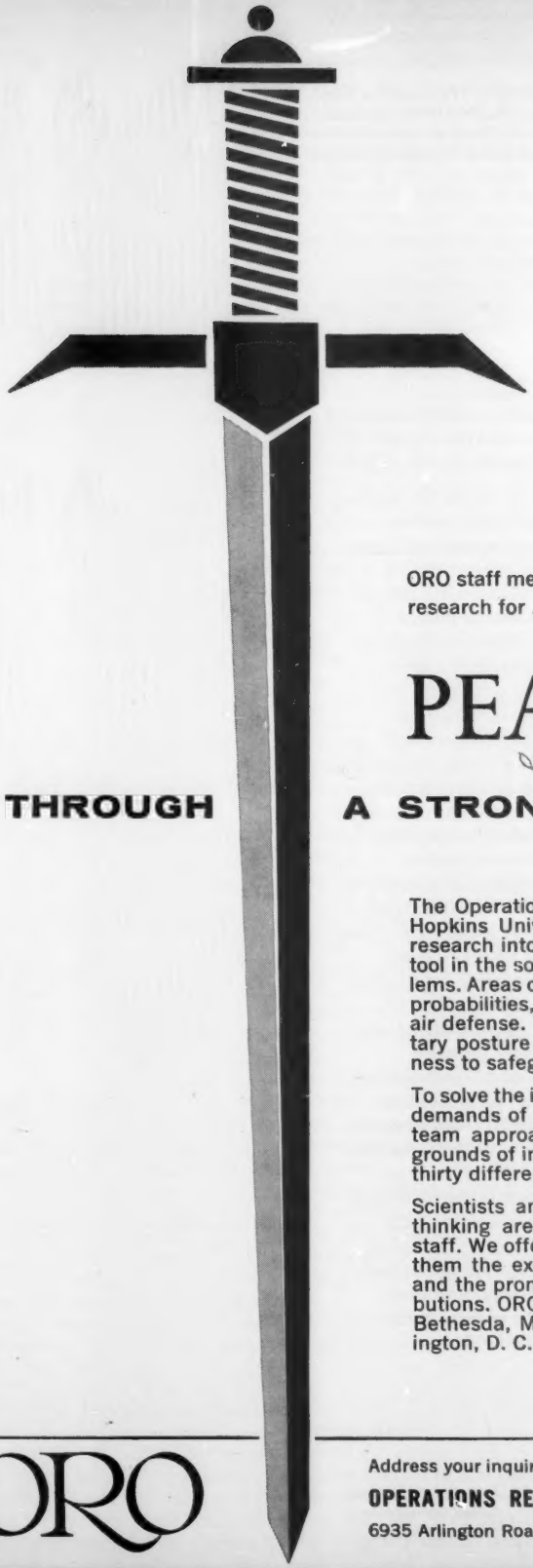
Please send me the volumes circled: 65 64 63 62 61 60 59 58 57 56 55 54 53 52 51

☐ Payment of $..... is enclosed. ☐ Please invoice at retail prices.

NAME .....

ADDRESS .....

CITY ..... ZONE ..... STATE .....



ORO staff members pioneer operations research for . . .

PEACE

THROUGH A STRONG DEFENSE

The Operations Research Office of the Johns Hopkins University has pioneered operations research into a powerful and flexible scientific tool in the solution of world-wide military problems. Areas of application include strategy, war probabilities, tactics, logistics, intelligence, and air defense. The result: a strong national military posture with improved operational readiness to safeguard the peace.

To solve the intricate problems posed by future demands of the Army, ORO employs a mixed-team approach combining the diverse backgrounds of individuals representing more than thirty different disciplines.

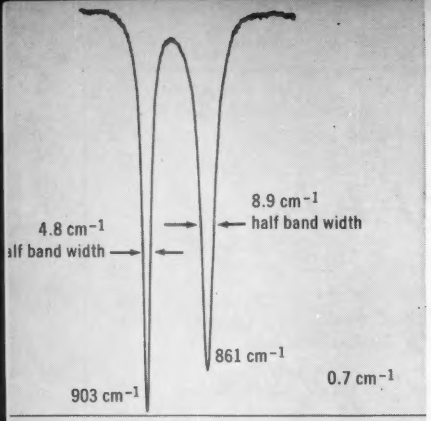
Scientists and engineers capable of creative thinking are invited to join our professional staff. We offer you assignments that carry with them the excitement of a pioneering venture and the promise of significant scientific contributions. ORO's modern facilities are located in Bethesda, Md., a residential suburb of Washington, D. C.

ORO

Address your inquiry to: John C. Burke, Research Personnel Officer

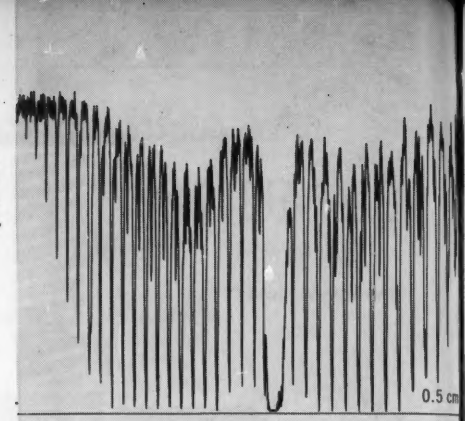
OPERATIONS RESEARCH OFFICE / The Johns Hopkins University

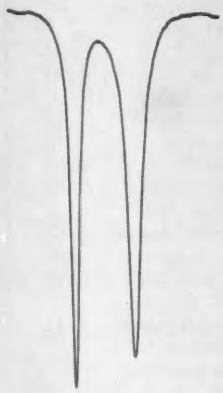
6935 Arlington Road • Bethesda 14, Maryland

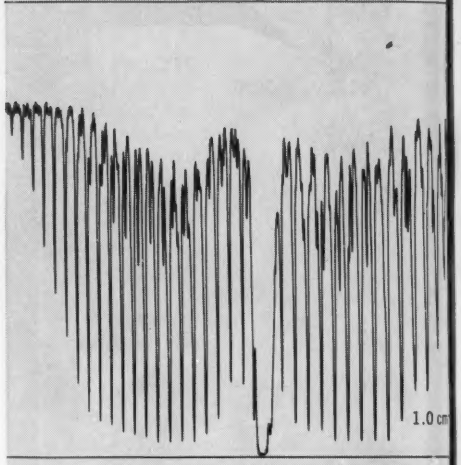


Left, spectrum of a 0.21 mm. thickness sample of spectro-grade cyclohexane demonstrates the importance of high resolution for routine quantitative analysis.

Right, the C-H stretching band of methane illustrates the increased research data obtainable with high resolution spectroscopy.

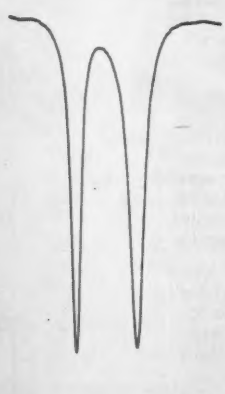


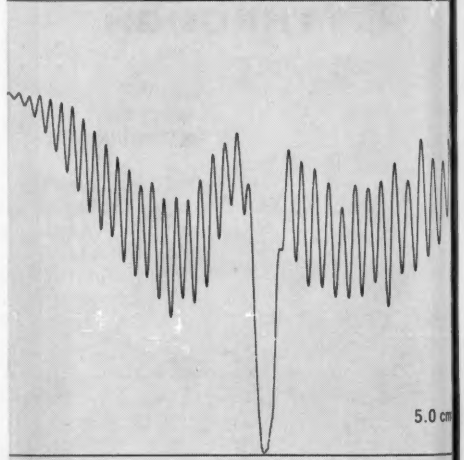


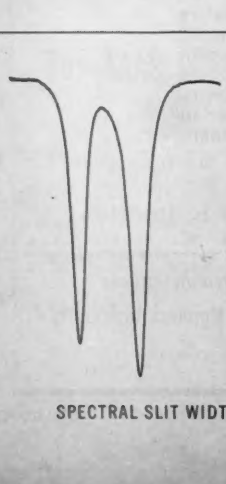


Beckman IR... highest resolution for routine quantitative analysis and advanced theoretical studies.

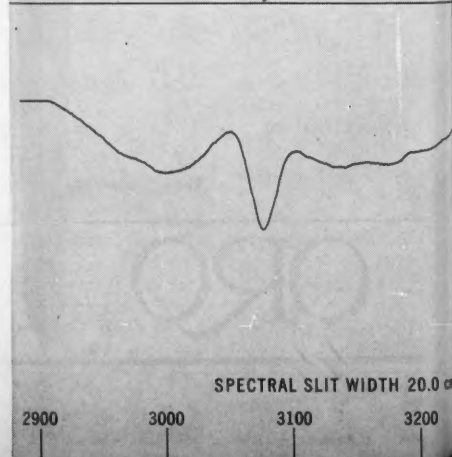
High resolution of the Beckman IR-7 does more than merely separate closely spaced neighboring bands. Note, for instance, how the apparent intensities of the two cyclohexane bands increase with higher resolution. The relatively greater increase in the intensity of the 903 cm^{-1} band at higher resolutions is the result of its narrower half-band width. These two commonly analyzed samples demonstrate the importance of high resolution in both low and high frequency regions and, for both gas and liquid samples. Comparative spectra were run with identical samples; slit width and resolutions, were varied as noted. ⌘ High resolution is essential for *all areas of spectroscopy;* for studies of molecular motion and structure, for differentiating between substances which exhibit similar spectra, and also for providing increased sensitivity and absolute accuracy for quantitative analysis. A further long-run advantage of high resolution is the increased potential for transferring data from one instrument to another. For more information about high resolution spectrophotometers, including indene spectra, write for Data File 38-1-02.







SPECTRAL SLIT WIDTH 8.0 cm^{-1}



SPECTRAL SLIT WIDTH 20.0 cm

Beckman
Scientific and Process Instruments Division
Beckman Instruments, Inc.
Fullerton, California

Beckman has BIG news for you at the Pittsburgh Symposium

Letters

Law of Aging

In their article "General theory of mortality and aging" [*Science* **132**, 14 (1960)], Strehler and Mildvan have determined the parameters R_0 and α in Gompertz's law of aging

$$R(t) = R_0 e^{\alpha t}$$

for a large number of relatively homogeneous human populations. $R(t)$ is the death rate in the population at age t. They find that most of the available demographic data are well fitted by Gompertz's law for ages 35 to 80 years. The authors then plot log R_0 versus α for the populations analyzed and find that the points lie in the vicinity of a straight line over the whole range, $0.7 < \alpha < 0.12$. This quite unexpected circumstance means that Gompertz's law is actually a one-parameter law, and that the various populations studied can be ordered and discussed in terms of this single quantity. For males, the relation between R_0 and α is

$$R_0 = 0.054\, e^{-70\alpha}$$

so that Gompertz's law becomes

$$R(t) = 0.054\, e^{\alpha(t-70)}$$

Comparing any two populations, we see that if one has a higher death rate than the other before 70 years, then after 70 its death rate is lower, and that every man alive at 70 has one chance in 18 of dying in that year, regardless of race and nationality. This is a curious aspect of the Biblical term of years.

DAVID PARK

Department of Physics,
Williams College,
Williamstown, Massachusetts

Needs in Engineering

The report of the Panel on Basic Research and Graduate Education [*Science* **132**, 1802 (1960)] is by far the soundest and, at the same time, most literate statement about the task facing American graduate education in science that I have seen. Emphatic recognition that the university should bear the principal responsibility for basic scientific discovery and that this same effort must also spawn our scientific talent in long overdue. The detailed discussion by the report of problems facing our universities is complete and farsighted within the field of basic science as such. Especially gratifying is the recognition that there should rightly be a number of great scientific universities throughout the nation, rather than a mere handful of elite ones. While better scientific education is desirable at all levels, and non-university basic research is certainly important, we cannot escape the fact that the real long-range key to greater achievement in science is the long-neglected graduate school. My personal fear is that the panel may have been too conservative in emphasizing the importance and magnitude of the things that need to be done.

While I recognize that the problem of graduate education in engineering may not have been directly within the assigned task of the panel, I am somewhat alarmed by the implication that engineering research may not be "directly included in our central analysis," and by the statement, "the question arises whether in this sector there is anything that can be done to advance the fruitful connection between basic research and graduate education." If this particular conclusion of the committee applies to graduate work in engineering, as it seems to, then I must sharply dissent. The position of scientific discovery in our social-economic system is a relatively simple one. The process of engineering synthesis occupies a much broader spectrum of human endeavor, and technology's relationship to science, not only as beneficiary but often as progenitor, is not well understood—not only by scientists but by engineers, university administrators, economists, and politicians as well. A similar lack of understanding of engineering in relation to economic and social progress widely exists. It is true that the engineering arts must be forged in the market place, but this complicates the task of the engineering graduate school, it does not eliminate it. It is a long step from scientific discovery to the invention and production of useful economic goods or applications.

Perhaps now that the task and needs of basic science have been so clearly stated, some attention should be given to the real nature and the needs of engineering. In this, engineers (many of them scientists) solicit the help and understanding of scientists (many of them also engineers), for we are now in even greater danger of falling behind here than in basic science.

D. F. PETERSON

College of Engineering,
Utah State University, Logan

Loyalty Oath

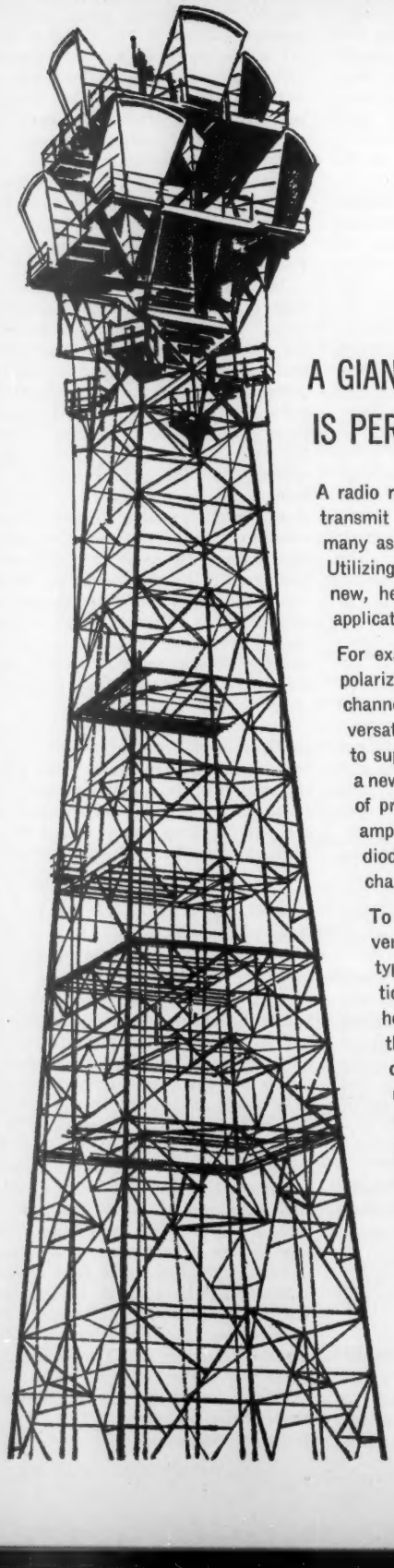
I am amazed to find that the National Science Foundation requires an applicant for its graduate fellowship to sign a loyalty oath. I recently requested and received an application for the fellowship to be awarded for academic year 1961–62, but since I feel that I cannot support any educational program which is contingent upon oaths, my application will not be submitted. The country's top educators have objected to such stipulations, but it is time for prospective graduate students also to speak out. I realize that much has already been said concerning the oaths in education, and I do not pretend to be familiar with all the issues involved; I can only state my own reasons for refusing to sign the National Science Foundation oath.

My first thought upon reading the oath form supplied by the foundation was, "how unnecessary!" It seems to me that if one is loyal to his country, such a written statement neither expresses fully his feelings of loyalty nor enhances them in any way; the superficial statement is, in fact, an insult to his deep convictions of loyalty. More importantly, the person who is not loyal would be most happy to sign, thus throwing off suspicion. If such a person commits treason, certainly signing a false oath is an insignificant offense as compared to his treasonous act. A disloyal person has everything to gain and very little to lose by signing. Therefore, I look upon oaths not just as unnecessary but as really dangerous, since they may lead us to false feelings of security.

But more importantly, why are *students* singled out as particular subjects of distrust? In these times, I read repeatedly in our news sources that scientists are needed and that the government is using many means to encourage scientific and engineering careers for individuals of my generation. And yet, paradoxically, in one of the very programs conceived to encourage these ends, open suspicion is directed at the prospective scientist through the loyalty oath. It would be less objectionable if *every* person in the country, before benefiting from a federally financed program of any kind, were required to sign such an oath; however, this is not the case. Financial support of a graduate student in the sciences is far from being a donation; it is an investment by the nation in a potential scientist. It is held by many persons to be axiomatic that academic freedom and alleviation of heavy financial burdens are two prime conditions necessary for the development of a creative scientist. Therefore, to be fully effective in achieving the goals of the National Science Foundation, fellowship programs must not continue to violate academic freedom with the requirement for loyalty oaths.

JACK P. HAILMAN

4401 Gladwyne Drive,
Bethesda, Maryland



A GIANT RADIO HIGHWAY IS PERFECTED FOR TELEPHONY

A radio relay system operating at 6 billion cycles per second and able to transmit 11,000 voices on a single beam of microwaves—several times as many as any previous system—has been developed at Bell Laboratories. Utilizing the assigned frequency band with unprecedented efficiency, this new, heavy-traffic system was made possible by the development and application of new technology by Bell Laboratories engineers and scientists.

For example, they arranged for the waves in adjacent channels to be polarized 90 degrees apart, thus cutting down interference between channels and permitting the transmission of many more telephone conversations in the same frequency space. They developed ferrite isolators to suppress interfering wave reflections in the waveguide circuits; and a new traveling wave tube that has ten times the power handling capacity of previous amplifiers and provides uniform and almost distortionless amplification of FM signals. They devised and applied a new high-speed diode switching system which instantly switches service to a protection channel when trouble threatens.

To transmit and receive the waves, the engineers applied their invention, the horn-reflector antenna. Elsewhere, this versatile antenna type is brilliantly aiding space communication research in the reception of radio signals from satellites. For radio relay, a single horn-reflector antenna can efficiently handle both polarizations of the 6000 megacycle waves of the new system; at the same time it can handle 4000 and 11,000 megacycle waves used for existing radio relay systems. Thus it enables all three systems to share economically the same radio towers and routes.

Produced by the Bell System's manufacturing unit, Western Electric, the new system is now in operation between Denver and Salt Lake City, and will gradually be extended from coast to coast. This new advance in radio technology is another example of how Bell Telephone Laboratories works to improve your Bell communication services.

BELL TELEPHONE LABORATORIES

World center of communications research and development

27 January 1961, Volume 133, Number 3448

SCIENCE

AMERICAN ASSOCIATION
FOR THE
ADVANCEMENT OF SCIENCE

Board of Directors

CHAUNCEY D. LEAKE, *Retiring President, Chairman*
THOMAS PARK, *President*
PAUL M. GROSS, *President Elect*

HARRISON BROWN — DON K. PRICE
HENRY EYRING — ALFRED S. ROMER
H. BENTLEY GLASS — WILLIAM W. RUBEY
MARGARET MEAD — ALAN T. WATERMAN
PAUL A. SCHERER, *Treasurer*
DAEL WOLFLE, *Executive Officer*

Editorial Board

KONRAD B. KRAUSKOPF — H. BURR STEINBACH
EDWIN M. LERNER — WILLIAM L. STRAUS, JR.
PHILIP M. MORSE — EDWARD L. TATUM

Editorial Staff

DAEL WOLFLE, *Publisher* — HANS NUSSBAUM, *Business Manager*
GRAHAM DUSHANE, *Editor*
JOSEPH TURNER, *Associate Editor* — ROBERT V. ORMES, *Managing Editor*
ELLEN E. MURPHY, *Assistant Editor*
NANCY TEIMOURIAN, *Assistant to the Editor*
News: HOWARD MARGOLIS, BETHSABE ASENJO
Book Reviews: SARAH S. DEES
Editorial Assistants: NANCY S. HAMILTON, EDGAR C. RICH, BARBARA SUTHERLAND, CONRAD YUNG-KWAI
Staff Assistants: PATRICIA D. PADDOCK, LOIS W. WOODWORTH

Advertising Staff

EARL J. SCHERAGO, *Director*
BERNICE SCHWARTZ, *Production Manager*
Sales: RICHARD L. CHARLES (New York, N.Y., PE 6-1858); C. RICHARD CALLIS (Old Bridge, N.J., CL 4-3680); HERBERT BURKLUND (Chicago, Ill., DE 7-4973); DILLENBECK-GALLAVAN (Los Angeles, Calif., DU 5-3991)

SCIENCE, now combined with THE SCIENTIFIC MONTHLY, is published each Friday by the American Association for the Advancement of Science at National Publishing Company, Washington, D.C. SCIENCE is indexed in the *Reader's Guide to Periodical Literature*.

Editorial correspondence should be addressed to SCIENCE, 1515 Massachusetts Ave., NW, Washington 5, D.C. Manuscripts should be typed with double spacing and submitted in duplicate. The AAAS assumes no responsibility for the safety of manuscripts or for the opinions expressed by contributors. For detailed suggestions on the preparation of manuscripts, see *Science* **125**, 16 (4 Jan. 1957).

Advertising correspondence should be addressed to SCIENCE, Room 740, 11 West 42 St., New York 36, N.Y.

Change of address notification should be sent to 1515 Massachusetts Ave., NW, Washington 5, D.C., 4 weeks in advance. If possible, furnish an address label from a recent issue. Give both old and new addresses, including zone numbers, if any.

Annual subscriptions: $8.50; foreign postage, $1.50; Canadian postage, 75¢. Single copies, 35¢. Cable address: Advancesci, Washington.

Copyright 1961 by the American Association for the Advancement of Science.

Advising the President on Manpower

The President needs, and gets, advice on a wide variety of matters. Among the more highly institutionalized sources, his Council of Economic Advisers exists by congressional statute, and his Science Advisory Committee by his own decision. His Task Force on Education has advocated an Advisory Committee on Education, and the President himself has hinted at the possibility of a comparable body to consider natural resources.

Before the structure of presidential advisory bodies grows too complex and compartmentalized, it would be well to consider the matter on a more comprehensive basis, or to consider advisory bodies that would deal with wider ranges of topics than any of those yet mentioned. Senator Clark made one such proposal last spring in recommending an Advisory Council on Manpower. He was thinking broadly of the optimal development and utilization of the nation's human resources. The advisers he had in mind would be an integrating force among the several agencies of the government that deal with, advise upon, or directly influence education, economic trends, the labor force, manpower distribution, and kindred matters.

There is a considerable number of such agencies, including the Office of Education, the National Institutes of Health, the National Science Foundation, the International Cooperation Administration, and the Departments of Agriculture, Defense, and Labor. They offer scholarships or fellowships to attract students into selected professions; they study manpower trends; their policies of utilization, taxation, and military service make some kinds of work more attractive than others. And the government itself employs millions of men and women for many kinds of work in many parts of the world.

When the government itself is doing so much both to study and to influence the development and utilization of the nation's human resources, it becomes almost obligatory to establish means by which the influences and their effects can be viewed as a whole. Because so many independent agencies of government are involved, it is only at the presidential level that responsibility for the over-all view can be exercised. Yet a statutory Advisory Council on Manpower may not be the proper means. Hearings on Senator Clark's bill in June and December elicited a good deal of support for an integrated review of the nation's human resources problems and a good deal of doubt concerning another statutory council of presidential advisers. It would be better, most witnesses agreed, to let the President select his own methods, so long as he accepts responsibility for establishing some adequate means of assuring continuing top-level attention to the vital problems of attaining optimal development and utilization of the nation's greatest source of strength, its wealth of human ability.

The burden of the presidency is already so great that one cannot lightly recommend the addition of a new responsibility. Yet the optimal development and utilization of human ability—the one natural resource for which there is no substitute—is so basic to the achievement of our national purposes and so fundamental an element of the democratic ideal that it is hard to think of a long-range problem more deserving of presidential attention, or more worthy of a periodic presidential report to the Congress and the nation.—D.W.

Today's best buy in a recording spectrophotometer!

...Spectronic 505® Recording Spectrophotometer
...from $3685, less than half the cost of the others

No other recording spectrophotometer has ever won such prompt acceptance. In just a few short months it has become the best seller in the field. And with good reason. High accuracy and speed of analysis make it a sensible buy for recording transmittance, linear absorbance, reflectance and emission throughout the UV and visible ranges. But consider its astonishingly low price ... add up its exclusive features ... and you'll see why so many laboratories have specified it as today's *best* buy.

- Certified-Precision Diffraction Gratings—high resolving power and linear dispersion; constant, narrow band pass.
- Exclusive electronic sensor—automatically gives faster, more accurate recording.
- Exclusive long life air-cooled Hydrogen lamp. No water cooling lines and drainage.
- Precise reflectance values are easily obtained.
- Only $3685, visible range; $4285, UV-Visible.

BAUSCH & LOMB
SINCE 1853

BAUSCH & LOMB INCORPORATED
75913 Bausch St., Rochester 2, N.Y.

☐ Send me Spectronic 505 Recording Spectrophotometer Catalog D-2009.

Name ..... *Title* .....
Company .....
Address .....
City ..... *Zone* ..... *State* .....

27 January 1961, Volume 133, Number 3448 SCIENCE

The Moral Un-Neutrality of Science

The scientist's special responsibilities are examined in an address given at the 1960 AAAS annual meeting.

Introduction by Warren Weaver

We live, as our grandparents did not, in a highly interconnected world.

The political, geographic, and communicative interconnections are made almost painfully obvious every morning when we listen to the radio news. Laos and Leopoldville, Moscow and Manila, Johannesburg and Jakarta are with us at the breakfast table, as immediate and pressing as the signal for the school bus. And across our evening sky there swims a communication satellite, symbol of the fact that both voice and vision can now extend over our whole planet.

Even more significant, however, are the new interconnections which are developing within the world of the mind. There used to be comforting compartments within any one of which a person could live and work and think, reasonably protected against—almost insulated from—the rest of the world of ideas. But, largely in the last half century, this has ceased to be so.

This vanishing of intellectual boundaries has, in particular, occurred inside science. About 1920 the line between chemistry and physics began to disappear. At superficial levels of application—the cookery level of chemistry and the hardware level of physics—one can still tell the two subjects apart. But fundamentally they have now become one.

Even more spectacular and surprising is the fact that biology is now in the process of becoming completely absorbed into and merged with all the rest of science. The modern molecular biologist is a chemist, a physicist, a mathematician, a submicroscopic cytologist—in short, a *scientist*. The origin of the elements, the origin of life, and the origin of species—these have now become interrelated parts of one grand problem.

In the good old days when chemistry still smelled like chemistry and biology stayed put inside the biology building, when physics was the harmless preoccupation of a few professors, when mathematics consisted of one useful part called arithmetic and a second part that any sensible person recognized as incomprehensible—in those good old days our grandfathers really did not have cause for much general worry or concern about science. One was relatively free to take it or leave it alone. Electric motors and lights and automobiles and better medicines and some improved seeds were becoming available, and that all seemed a good idea. A very few persons were confused and troubled about what they supposed science had to say about religion. The poets occasionally sneered at science, but this was pretty well canceled out by the fact that scientists kept on reading poetry.

Although there were a few prophets, the vast proportion of men knew little or nothing about science and did not—at least consciously or obviously—suffer from that fact.

This has now all been changed. We now realize that science cannot be disregarded. We now know that science is intertwined not only with political and economic problems but with all the concerns of the humanists and artists. We now know that the mind and spirit of man approaches reality from many directions, appreciates order and beauty in many manifestations, and by joining all forces brings creative imagination and revealing insight to bear on all aspects of nature, of life, and of living. We now know that the poet and the physicist, the musician and the mathematician, the artist and the statesman, and the philosopher and the astronomer attack their problems with essentially the same intellectual and spiritual resources.

But although everyone realizes that our geographical world has become one and that the political world is intimately interrelated, most men are more tardy, or more reluctant, to recognize and profit by the emerging unity of the world of the mind.

Sir Charles Percy Snow has become recognized as the most authoritative and most moving spokesman for the view that we must rejoin the pieces of our fractured culture, must restore the unity of the world of the mind. Himself a distinguished practitioner in science and in the creative arts, he has made a responsible and reasoned plea that our culture be a unified one.

He speaks to us on a theme which

Dr. Weaver is vice president of the Alfred P. Sloan Foundation, New York; Sir Charles P. Snow, British author, is currently visiting professor of English at the University of California, Berkeley; Father Hesburgh is president of the University of Notre Dame; and Dr. Baker is vice president for research of the Bell Telephone Laboratories, Murray Hill, N.J. Sir Charles's address and the accompanying remarks were delivered 27 December in New York.

deals with one of the most interesting and difficult aspects of the interrelatedness of science with all the rest of life, an interrelationship which many disregard, which most debate, and which some deny—the moral unneutrality of science.

Address by Charles P. Snow

Scientists are the most important occupational group in the world today. At this moment, what they do is of passionate concern to the whole of human society. At this moment, the scientists have little influence on the world effect of what they do. Yet, potentially, they can have great influence. The rest of the world is frightened both of what they do—that is, of the intellectual discoveries of science—and of its effect. The rest of the world, transferring its fears, is frightened of the scientists themselves and tends to think of them as radically different from other men.

As an ex-scientist, if I may call myself so, I know that is nonsense. I have even tried to express in fiction some kinds of scientific temperament and scientific experience. I know well enough that scientists are very much like other men. After all, we are all human, even if some of us don't give that appearance. I think I would be prepared to risk a generalization. The scientists I have known (and because of my official life I have known as many as anyone in the world) have been in certain respects just perceptibly more morally admirable than most other groups of intelligent men.

That is a sweeping statement, and I mean it only in a statistical sense. But I think there is just a little in it. The moral qualities I admire in scientists are quite simple ones, but I am very suspicious of attempts to oversubtilize moral qualities. It is nearly always a sign, not of true sophistication, but of a specific kind of triviality. So I admire in scientists very simple virtues—like courage, truth-telling, kindness—in which, judged by the low standards which the rest of us manage to achieve, the scientists are not deficient. I think on the whole the scientists make slightly better husbands and fathers than most of us, and I admire them for it. I don't know the figures, and I should be curious to have them sorted out, but I am prepared to bet that the proportion of divorces among scientists is slightly but significantly less than that among other groups of similar education and income. I do not apologize for considering that a good thing.

A close friend of mine is a very distinguished scientist. He is also one of the few scientists I know who has lived what we used to call a Bohemian life. When we were both younger, he thought he would undertake historical research to see how many great scientists had been as fond of women as he was. I think he would have felt mildly supported if he could have found a precedent. I remember his reporting to me that his researches hadn't had any luck. The really great scientists seemed to vary from a few neutral characters to a large number who were depressingly "normal." The only gleam of comfort was to be found in the life of Jerome Cardan; and Cardan wasn't anything like enough to outweigh all the others.

So scientists are not much different from other men. They are certainly no worse than other men. But they do differ from other men in one thing. That is the point I started with. Whether they like it or not, what they do is of critical importance for the human race. Intellectually, it has transformed the climate of our time. Socially, it will decide whether we live or die, and how we live or die. It holds decisive powers for good and evil. *That* is the situation in which the scientists find themselves. They may not have asked for it, or may only have asked for it in part, but they cannot escape it. They think, many of the more sensitive of them, that they don't deserve to have this weight of responsibility heaved upon them. All they want to do is to get on with their work. I sympathize. But the scientists can't escape the responsibility—any more than they, or the rest of us, can escape the gravity of the moment in which we stand.

Doctrine of Ethical Neutrality

There is of course one way to contract out. It has been a favorite way for intellectual persons caught in the midst of water too rough for them.

It consists of the invention of categories—or, if you like, of the division of moral labor. That is, the scientists who want to contract out say, *we* produce the tools. *We* stop there. It is for *you*—the rest of the world, the politicians—to say how the tools are used. The tools may be used for purposes which most of us would regard as bad. If so, we are sorry. But as scientists, that is no concern of ours.

This is the doctrine of the ethical neutrality of science. I can't accept it for an instant. I don't believe any scientist of serious feeling can accept it. It is hard, some think, to find the precise statements which will prove it wrong. Yet we nearly all feel intuitively that the invention of comfortable categories is a moral trap. It is one of the easier methods of letting the conscience rust. It is exactly what the early 19th century economists, such as Ricardo, did in the face of the facts of the first industrial revolution. We wonder now how men, intelligent men, can have been so morally blind. We realize how the exposure of that moral blindness gave Marxism its apocalyptic force. We are now, in the middle of the scientific or second industrial revolution, in something like the same position as Ricardo. Are we going to let our consciences rust? Can we ignore that intimation we nearly all have, that scientists have a unique responsibility? Can we believe it, that science is morally neutral?

To me—it would be dishonest to pretend otherwise—there is only one answer to those questions. Yet I have been brought up in the presence of the same intellectual categories as most western scientists. It would also be dishonest to pretend that I find it easy to construct a rationale which expresses what I now believe. The best I can hope for is to fire a few sighting shots. Perhaps someone who sees more clearly than I can will come along and make a real job of it.

The Beauty of Science

Let me begin with a remark which seems some way off the point. Anyone who has ever worked in any science knows how much esthetic joy he has obtained. That is, in the actual *activity* of science, in the process of making a discovery, however humble it is, one can't help feeling an awareness of beauty. The subjective experience, the esthetic satisfaction, seems exactly the same as the satisfaction one gets from writing a poem or a novel, or composing a piece of music. I don't think anyone has succeeded in distinguishing between them. The literature of scientific discovery is full of this esthetic joy. The very best communication of it that I know comes in G. H. Hardy's book, *A Mathematician's Apology*. Graham Greene once said he thought that, along with Henry James's prefaces, this was the best account of the artistic experience ever written. But one meets the

same thing throughout the history of science. Bolyai's great yell of triumph when he saw he could construct a self-consistent, non-Euclidean geometry; Rutherford's revelation to his colleagues that he knew what the atom was like; Darwin's slow, patient, timorous certainty that at last he had got there—all these are voices, different voices, of esthetic ecstasy.

That is not the end of it. The *result* of the activity of science, the actual finished piece of scientific work, has an esthetic value in itself. The judgments passed on it by other scientists will more often than not be expressed in esthetic terms: "That's beautiful!" or "That really is very pretty!" (as the understating English tend to say). The esthetics of scientific constructs, like the esthetics of works of art, are variegated. We think some of the great syntheses, like Newton's, beautiful because of their classical simplicity, but we see a different kind of beauty in the relativistic extension of the wave equation or the interpretation of the structure of deoxyribonucleic acid, perhaps because of the touch of unexpectedness. Scientists know their kinds of beauty when they see them. They are suspicious, and scientific history shows they have always been right to have been so, when a subject is in an "ugly" state. For example, most physicists feel in their bones that the present bizarre assembly of nuclear particles, as grotesque as a stamp collection, can't possibly be, in the long run, the last word.

We should not restrict the esthetic values to what we call "pure" science. Applied science has its beauties, which are, in my view, identical in nature. The magnetron has been a marvelously useful device, but it was a beautiful device, not exactly apart from its utility but because it did, with such supreme economy, precisely what it was designed to do. Right down in the field of development, the esthetic experience is as real to engineers. When they forget it, when they begin to design heavy-power equipment about twice as heavy as it needs to be, engineers are the first to know that they are lacking virtue.

There is no doubt, then, about the esthetic content of science, both in the activity and the result. But esthetics has no connection with morals, say the categorizers. I don't want to waste time on peripheral issues—but are you quite sure of that? Or is it possible that these categories are inventions to make us evade the human and social conditions in which we now exist? But let us move straight on to something else, which is right in the grain of the activity of science and which is at the same time quintessentially moral. I mean, the desire to find the truth.

The Search for Truth

By *truth*, I don't intend anything complicated, once again. I am using the word as a scientist uses it. We all know that the philosophical examination of the concept of empirical truth gets us into some curious complexities, but most scientists really don't care. They know that the truth, as they use the word and as the rest of us use it in the language of common speech, is what makes science work. That is good enough for them. On it rests the whole great edifice of modern science. They have a sneaking sympathy for Rutherford, who, when asked to examine the philosophical bases of science, was inclined to reply, as he did to the metaphysician Samuel Alexander: "Well, what have you been talking all your life, Alexander? Just hot air! Nothing but hot air!"

Anyway, truth in their own straightforward sense is what the scientists are trying to find. They want to find what is *there*. Without that desire, there is no science. It is the driving force of the whole activity. It compels the scientist to have an overriding respect for truth, every stretch of the way. That is, if you're going to find what is *there*, you mustn't deceive yourself or anyone else. You mustn't lie to yourself. At the crudest level, you mustn't fake your experiments.

Curiously enough, scientists do try to behave like that. A short time ago, I wrote a novel in which the story hinged on a case of scientific fraud. But I made one of my characters, who was himself a very good scientist, say that, considering the opportunities and temptations, it is astonishing how few such cases there are. We have all heard of perhaps half a dozen open and notorious ones, which are on the record for anyone to read—ranging from the "discovery" of the L radiation to the singular episode of the Piltdown man.

We have all, if we have lived any time in the scientific world, heard private talk of something like another dozen cases which for various reasons are not yet public property. In some cases, we know the motives for the cheating—sometimes, but not always, sheer personal advantage, such as getting money or a job. But not always. A special kind of vanity has led more than one man into scientific faking. At a lower level of research, there are presumably some more cases. There must have been occasional Ph.D. students who scraped by with the help of a bit of fraud.

But the total number of all these men is vanishingly small by the side of the total number of scientists. Incidentally, the effect on science of such frauds is also vanishingly small. Science is a self-correcting system. That is, no fraud (or honest mistake) is going to stay undetected for long. There is no need for an extrinsic scientific criticism, because criticism is inherent in the process itself. So that all that a fraud can do is waste the time of the scientists who have to clear it up.

The remarkable thing is not the handful of scientists who deviate from the search for truth but the overwhelming numbers who keep to it. That is a demonstration, absolutely clear for anyone to see, of moral behavior on a very large scale.

We take it for granted. Yet it is very important. It differentiates science in its widest sense (which includes scholarship) from all other intellectual activities. There is a built-in moral component right in the core of the scientific activity itself. The desire to find the truth is itself a moral impulse, or at least contains a moral impulse. The way in which a scientist tries to find the truth imposes on him a constant moral discipline. We say a scientific conclusion—such as the contradiction of parity by Lee and Yang—is "true" in the limited sense of scientific truth, just as we say that it is "beautiful" according to the criteria of scientific esthetics. We also know that to reach this conclusion took a set of actions which would have been useless without the moral nature. That is, all through the marvelous experiments of Wu and her colleagues, there was the constant moral exercise of seeking and telling the truth. To scientists, who are brought up in this climate, this seems as natural as breathing. Yet it is a wonderful thing. Even if the scientific activity contained only this one moral component, that alone would be enough to let us say that it was morally un-neutral.

But is this the only moral component? All scientists would agree about the beauty and the truth. In the western world, they wouldn't agree on much more. Some will feel with me in what I am going to say. Some will not. That

doesn't affect me much, except that I am worried by the growth of an attitude I think very dangerous, a kind of technological conformity disguised as cynicism. I shall say a little more about that later. As for disagreement, G. H. Hardy used to comment that a serious man ought not to waste his time stating a majority opinion—there are plenty of others to do that. That was the voice of classical scientific nonconformity. I wish that we heard it more often.

Science in the Twenties

Let me cite some grounds for hope. Any of us who were working in science before 1933 can remember what the atmosphere was like. It is a terrible bore when aging men in their fifties speak about the charms of their youth. Yet I am going to irritate you—just as Talleyrand irritated his juniors—by saying that unless one was on the scene before 1933, one hasn't known the sweetness of the scientific life. The scientific world of the twenties was as near to being a full-fledged international community as we are likely to get. Don't think I'm saying that the men involved were superhuman or free from the ordinary frailties. That wouldn't come well from me, who have spent a fraction of my writing life pointing out that scientists are, first and foremost, men. But the atmosphere of the twenties in science was filled with an air of benevolence and magnanimity which transcended the people who lived in it.

Anyone who ever spent a week in Cambridge or Göttingen or Copenhagen felt it all round him. Rutherford had very human faults, but he was a great man with abounding human generosity. For him the world of science was a world that lived on a plane above the nation-state, and lived there with joy. That was at least as true of those two other great men, Niels Bohr and Franck, and some of that spirit rubbed off on to the pupils round them. The same was true of the Roman school of physics.

The personal links within this international world were very close. It is worth remembering that Peter Kapitza, who was a loyal Soviet citizen, honored my country by working in Rutherford's laboratory for many years. He became a fellow of the Royal Society, a fellow of Trinity College, Cambridge, and the founder and kingpin of the best physics club Cambridge has known. He never gave up his Soviet citizenship and is now director of the Institute of Physical Problems in Moscow. Through him a generation of English scientists came to have personal knowledge of their Russian colleagues. These exchanges were then, and have remained, more valuable than all the diplomatic exchanges ever invented.

The Kapitza phenomenon couldn't take place now. I hope to live to see the day when a young Kapitza can once more work for 16 years in Berkeley or Cambridge and then go back to an eminent place in his own country. When that can happen, we are all right. But after the idyllic years of world science, we passed into a tempest of history, and, by an unfortunate coincidence, we passed into a technological tempest too.

The discovery of atomic fission broke up the world of international physics. "This has killed a beautiful subject," said Mark Oliphant, the father figure of Australian physics, in 1945, after the bombs had dropped. In intellectual terms, he has not turned out to be right. In spiritual and moral terms, I sometimes think he has.

A good deal of the international community of science remains in other fields—in great areas of biology, for example. Many biologists are feeling the identical liberation, the identical joy at taking part in a magnanimous enterprise, that physicists felt in the twenties. It is more than likely that the moral and intellectual leadership of science will pass to biologists, and it is among them that we shall find the Rutherfords, Bohrs, and Francks of the next generation.

The Physicist, a Military Resource

Physicists have had a bitterer task. With the discovery of fission, and with some technical breakthroughs in electronics, physicists became, almost overnight, the most important military resource a nation-state could call on. A large number of physicists became soldiers not in uniform. So they have remained, in the advanced societies, ever since.

It is very difficult to see what else they could have done. All this began in the Hitler war. Most scientists thought then that Nazism was as near absolute evil as a human society can manage. I myself thought so. I still think so, without qualification. That being so, Nazism had to be fought, and since the Nazis might make fission bombs—which we thought possible until 1944, and which was a continual nightmare if one was remotely in the know—well, then, we had to make them too. Unless one was an unlimited pacifist, there was nothing else to do. And unlimited pacificism is a position which most of us cannot sustain.

Therefore I respect, and to a large extent share, the moral attitudes of those scientists who devoted themselves to making the bomb. But the trouble is, when you get onto any kind of moral escalator, to know whether you're ever going to be able to get off. When scientists became soldiers they gave up something, so imperceptibly that they didn't realize it, of the full scientific life. Not intellectually. I see no evidence that scientific work on weapons of maximum destruction has been in any intellectual respect different from other scientific work. But there is a moral difference.

It may be—scientists who are better men than I am often take this attitude, and I have tried to represent it faithfully in one of my books—that this is a moral price which, in certain circumstances, has to be paid. Nevertheless, it is no good pretending that there is not a moral price. Soldiers have to obey. That is the foundation of their morality. It is not the foundation of the scientific morality. Scientists have to question and if necessary to rebel. I don't want to be misunderstood. I am no anarchist. I am not suggesting that loyalty is not a prime virtue. I am not saying that all rebellion is good. But I am saying that loyalty can easily turn into conformity, and that conformity can often be a cloak for the timid and self-seeking. So can obedience, carried to the limit. When you think of the long and gloomy history of man, you will find that far more, and far more hideous, crimes have been committed in the name of obedience than have ever been committed in the name of rebellion. If you doubt that, read William Shirer's *Rise and Fall of the Third Reich*. The German officer corps were brought up in the most rigorous code of obedience. To them, no more honorable and God-fearing body of men could conceivably exist. Yet in the name of obedience, they were party to, and assisted in, the most wicked large-scale actions in the history of the world.

Scientists must not go that way. Yet the duty to question is not much of a support when you are living in the middle of an organized society. I speak with feeling here. I was an official for 20 years. I went into official life at the beginning of the war, for the reasons that prompted my scientific friends to begin to make weapons. I stayed in that life until a year ago, for the same reason that made my scientific friends turn

into civilian soldiers. The official's life in England is not quite so disciplined as a soldier's, but it is very nearly so. I think I know the virtues, which are very great, of the men who live that disciplined life. I also know what for me was the moral trap. I, too, had got onto an escalator. I can put the result in a sentence: I was coming to hide behind the institution; I was losing the power to say no.

A Spur to Moral Action

Only a very bold man, when he is a member of an organized society, can keep the power to say no. I tell you that, not being a very bold man, or one who finds it congenial to stand alone, away from his colleagues. We can't expect many scientists to do it. Is there any tougher ground for them to stand on? I suggest to you that there is. I believe that there is a spring of moral action in the scientific activity which is at least as strong as the search for truth. The name of this spring is *knowledge*. Scientists *know* certain things in a fashion more immediate and more certain than those who don't comprehend what science is. Unless we are abnormally weak or abnormally wicked men, this knowledge is bound to shape our actions. Most of us are timid, but to an extent, knowledge gives us guts. Perhaps it can give us guts strong enough for the jobs in hand.

I had better take the most obvious example. All physical scientists *know* that it is relatively easy to make plutonium. We know this, not as a journalistic fact at second hand, but as a fact in our own experience. We can work out the number of scientific and engineering personnel needed for a nation-state to equip itself with fission and fusion bombs. We *know* that, for a dozen or more states, it will only take perhaps six years, perhaps less. Even the best informed of us always exaggerate these periods.

This we know, with the certainty of —what shall I call it?—engineering truth. We also—most of us—are familiar with statistics and the nature of odds. We know, with the certainty of statistical truth, that if enough of these weapons are made, by enough different states, some of them are going to blow up, through accident, or folly, or madness—the motives don't matter. What does matter is the nature of the statistical fact.

All this we *know*. We know it in a more direct sense than any politician because it comes from our direct experience. It is part of our minds. Are we going to let it happen?

All this we *know*. It throws upon scientists a direct and personal responsibility. It is not enough to say that scientists have a responsibility as citizens. They have a much greater one than that, and one different in kind. For scientists have a moral imperative to say what they know. It is going to make them unpopular in their own nation-states. It may do worse than make them unpopular. That doesn't matter. Or at least, it does matter to you and me, but it must not count in the face of the risks.

Alternatives

For we genuinely know the risks. We are faced with an either-or, and we haven't much time. The *either* is acceptance of a restriction of nuclear armaments. This is going to begin, just as a token, with an agreement on the stopping of nuclear tests. The United States is not going to get the 99.9-percent "security" that it has been asking for. This is unobtainable, though there are other bargains that the United States could probably secure. I am not going to conceal from you that this course involves certain risks. They are quite obvious, and no honest man is going to blink them. That is the *either*. The *or* is not a risk but a certainty. It is this. There is no agreement on tests. The nuclear arms race between the United States and the U.S.S.R. not only continues but accelerates. Other countries join in. Within, at the most, six years, China and several other states have a stock of nuclear bombs. Within, at the most, ten years, some of those bombs are going off. I am saying this as responsibly as I can. *That* is the certainty. On the one side, therefore, we have a finite risk. On the other side we have a certainty of disaster. Between a risk and a certainty, a sane man does not hesitate.

It is the plain duty of scientists to explain this either-or. It is a duty which seems to me to come from the moral nature of the scientific activity itself.

The same duty, though in a much more pleasant form, arises with respect to the benevolent powers of science. For scientists know, and again with the certainty of scientific knowledge, that we possess every scientific fact we need to transform the physical life of half the world. And transform it within the span of people now living. I mean, we have all the resources to help half the world live as long as we do and eat enough. All that is missing is the will. We *know* that. Just as we know that you in the United States, and to a slightly lesser extent we in the United Kingdom, have been almost unimaginably lucky. We are sitting like people in a smart and cozy restaurant and we are eating comfortably, looking out of the window into the streets. Down on the pavement are people who are looking up at us, people who by chance have different colored skins from ours, and are rather hungry. Do you wonder that they don't like us all that much? Do you wonder that we sometimes feel ashamed of ourselves, as we look out through that plate glass?

Well, it is within our power to get started on that problem. We are morally impelled to. We all know that, if the human species does solve that one, there will be consequences which are themselves problems. For instance, the population of the world will become embarrassingly large. But that is another challenge. There are going to be challenges to our intelligence and to our moral nature as long as man remains man. After all, a challenge is not, as the word is coming to be used, an excuse for slinking off and doing nothing. A challenge is something to be picked up.

For all these reasons, I believe the world community of scientists has a final responsibility upon it—a greater responsibility than is pressing on any other body of men. I do not pretend to know how they will bear this responsibility. These may be famous last words, but I have an inextinguishable hope. For, as I have said, there is no doubt that the scientific activity is both beautiful and truthful. I cannot prove it, but I believe that, simply because scientists cannot escape their own knowledge, they also won't be able to avoid showing themselves disposed to good.

Comments by Theodore M. Hesburgh, C.S.C.

Sir Charles has wonderfully spoken to us as an ex-scientist. At the risk of coining an ambiguous word, I speak to you as a pro-scientist. I began intellectually hoping to be a philosopher. Then, I spent six years in the graduate study of theology, which I subsequently taught. I have this in common with Sir Charles, that shortly thereafter it appeared that a lifetime devoted to my first love was not to be, and I became an administrator. This led me into association with scientists.

Since then, I have spent almost seven years on the National Science Board, five years with high-energy physicists on the Midwestern Universities Research Association, five years concerned with atoms-for-peace in the General Conference of the International Atomic Energy Agency in Vienna, five years with the Nutrition Foundation, three years with the Physical Science Study Committee, and three years with all sorts of scientists on the Policy Advisory Board of the Argonne National Laboratory. While we all resent guilt by association, I trust that members of this association will turn the coin and accept the fact that I favor science and am, therefore, a pro-scientist.

Sir Charles has spoken frankly. I want to be equally frank. Much of what he has said I accept gladly and acclaim. Some other opinions of his I question. In the area of agreement, I am probably wasting my time by stating a majority opinion, but at least it gets us off to a good start.

I agree with full heart that the present-day scientist cannot be morally neutral. Neither can the man of any other profession, because neutrality is an illusion. The most fundamental ethical fact is that we are responsible for our actions and, to some extent, for the consequences of our actions. In the complexity of modern society, moral responsibility does, of course, become correspondingly complex, and there certainly is the tendency, which Sir Charles notes, to contract out that which one may not legitimately pass into another's hands and be completely done with. I believe that Robert Oppenheimer had something of this thought when he remarked after Nagasaki and Hiroshima that at last the scientist has known sin.

Science as a Power for Good

One need not, however, be exclusively concerned with the evil that is done through the instrumentality of science. Sir Charles has lightly touched upon science as a means of great good in the social order. Personally, I believe that here is an area where the scientist can atone for sin. No human being relishes the thought that other human beings are miserable, sick or hungry, homeless or without hope, when modern science has it within its grasp to bring relief. I am always slightly sickened at the thought that we spend more in this country for one atomic submarine than for the totality of agricultural research. We know that half of the food crop of hungry nations is destroyed by rot, sprouting, and bacteria, and we know that radiation can preserve these essential foods, and yet we have not devised a workable program to double the food supply of the hungry. We know that malaria can be exterminated. We know how to do this effectively, but we have not pressed for a program to do it, although people continue to die unnecessarily of malaria. We know that desalinization of sea or brackish water is essential to food production in some hungry nations, we know something of what chemical fertilizers can do, and yet we have not used our knowledge to press home the performance. We are geniuses at organization, and yet, though the world food production has grown faster than the world population, we have not clamored for effective means to get the food where the hunger is.

I believe that science today has the magnificent power of creating conditions that will allow man, for the first time in recorded history, to master the created universe in such a way that human dignity can rise above the miserable conditions that reduce man to little better than an animal. Will we use this power to help our fellow man, or will we use it to multiply our own luxuries? This is the question that perplexes me when I think of the personal moral responsibility of scientists.

Science is by its nature neutral. It can be used for good or evil. It is man, the scientist, who directs its use. I agree that the scientist is totally and rather universally committed to truth, that he does not falsify evidence, but I think we should not, from this fact alone, pass out halos to a profession of persons doing that which is essential to success and status in their profession. To say that a man does not do that which, if done, would ruin him is not cause for the highest paean of praise, although this line of reasoning is comparable to that which is theologically employed when fear of hell gets more emphasis in religion than love of God and our fellow men.

Ethical Problems of All Men

As you may have suspected, I am edging toward an area of disagreement with Sir Charles. Scientists do well in their commitment to truth and beauty; without this commitment we would not find so many admirable and decently human people among the scientists. But there are generally admitted to be four transcendentals, discrete yet clearly identified. Truth and beauty are two of them, being and the good are the others. *Being* gets us into metaphysics, which I personally find slightly more complicated than physics (maybe that is why they call it the science beyond physics). The sciences traditionally dealing with the good are ethics and moral theology. Scientists may ignore them or deny them if they wish, for ethics and moral theology employ different methods in getting at truth and view it in a broader context than that of "what makes science work," but I submit that the ignoring of ethics and moral theology is ignorance of a more serious nature than that which attends inadequate science. Plato and Aristotle, and their Christian counterparts, Augustine and Aquinas, had some deep and relevant reflections upon the nature of what is good and what is man's good, and of what the philosophical and theological means of determining these are. I quite agree that alongside of these giants of the human intellect at work, much of what is termed philosophy today is indeed, in the words of Rutherford, "hot air," but what they had to say about the ethical problems of all men of all times is air of greatest purity. Any scientist may read and dismiss them as irrelevant, but he may not dismiss them without reading them, for this is in a sense the mortal sin of science—not looking at all the evidence at hand.

Crucial Problem of Our Age

One last word about the most crucial problem of our age: survival. I am not convinced that the "either-or" is completely responsive to the situation that confronts us. I agree with Sir Charles that naive pacifism is out. Read Constantine Fitzgibbon's *When the Kissing Had To Stop* if you still have any doubts.

On the other hand, getting back to Sir Charles's "either-or," allow me to distrust statistical certainty where men are involved. One might make a good case for the statistical certainty of the use of gas in the last war: the side that was losing had it; it had been used before; they were desperate. As to the risk, suppose we sacrifice realistic demands for adequate inspection and control and disarm. Suppose the opposition cheats and the final result is world domination by the Soviets. I submit that in this eventuality we have a world in which you and I live, but really have nothing to live for.

Returning to an earlier page of Sir Charles, I would like to underline that science is one of those areas in which

men, in a very troubled world, may collaborate despite widely separated philosophical differences. Possibly the commitment to scientific truth and beauty is strong enough in this world to bridge the gap and establish a brotherhood impossible along ideological lines. I have seen this happen in my atoms-for-peace work. Here is a special strength of science: that men who love her dearly find a world in which mutual respect and friendship are strengthened in the pursuit of a common goal. Let us hope that the pursuit of truth, and the love of beauty, lead all the scientists of all the world toward that goal that we all seek—the good that science makes possible to human beings who live in hope of a better world than that which we now inhabit.

Comments by William O. Baker

I am honored to respond, on behalf of the community of scientists, to the compelling issues drawn up so deftly in Sir Charles's address.

I should say, first, that few, if any, scientists in the free world would be against his contentions about moral values and responsibilities. Therefore, I can most gainfully remark on a rather practical aspect of the matter, as becomes an industrialist—that is, the old query of what to do and how to do it, concerning public morality, since the matter of doing it or not is so convincingly treated by Sir Charles.

Thus, how can the scientists best labor in the macrocosmos of the world outside their laboratories and libraries? This is what I shall try to answer.

First, above all, they must gain public trust and understanding, even though, because of its inner qualities, political and social judgments derived from science may be less perfect than expected. Second, scientists must carry forth to all the world the bright hope, the good fortune, that science does betoken for mankind. We can indeed negate the spreading cynicism and nihilism of our time. Both are alien to science and to research. Science gainsays the words of a present-day anthropologist: "America is the only culture which has passed from barbarism to decline without going through a stage of civilization."

Science and its fruits do indeed confer that joy and sense of beauty—the esthetic content, as Sir Charles says—that can give our times social strength and buoyancy and *liveliness*. A society caught up in the great adventure of an Echo satellite, a reconstructed biological gene, a niobium-tin compound superconductor operating far above absolute zero—this will not lapse into Huxley's "Brave New World." Free people of today are ready to take up Wordsworth's offer:

> Come forth into the light of things,
> Let Nature be your teacher.
> She has a world of ready wealth,
> Our minds and hearts to bless—
> Spontaneous wisdom breathed by health,
> Truth breathed by cheerfulness.

So, over all, scientists must learn to *express* just those human virtues which Sir Charles said so kindly in his opening words were theirs.

Public Faith and Following

But now we have to go back to the first urgency for scientists—public faith and public following. The simple fact now is that scientists do not have the trust of people and of nations in dealing with the issues that Sir Charles raises—the issues of peace and war, of feast and famine, of life and death in their temporal forms. This is not a complaint; it is a realization. I could support this assertion by many grievous examples. Following Sir Charles's theme, I shall, however, refer to only two. The first is the action that followed the scientific communities' plea of 1945–46 to achieve immediately nuclear disarmament and agreement on nuclear weapons between all nations of the world. Some statesmen in our own government indeed cared deeply about this issue. Some scientists worked hard with them to awaken the world and its politics to the nuclear terror shortly to come. These scientists enlisted others in an effort to see whether what looked to many like a monopoly of nuclear weapons would soon be a world-wide nuclear arms race.

I happened to be one of a task force that was gathered officially, with State Department sanction, at the very beginning of 1946 to prepare a detailed scientific estimate of just what Sir Charles now speaks of as an "engineering truth." We found, of course, the engineering truth that another country, explicitly the Soviet Union, would have nuclear weapons in a certain number of years after 1946—a number which we carefully estimated. Our estimate, which is a matter of record, was off by little more than a year, and it was, indeed, too conservative an estimate. But it was by no means trusted, and—an equally sorry circumstance—we lacked the skill to make people believe and heed it.

A somewhat similar but rather more complex situation besets us now in regard to the nuclear test ban. You remember that, following the technical agreement of the summer of 1958 for a test detection network, scientists working on the subject were obliged drastically to revise their estimate of the known efficiency of detection of nuclear events. This necessity and subsequent studies of the subject have aroused a widespread mistrust among national leaders, and perhaps among the populace at large, concerning the reliability of scientific judgments and decisions.

Limitations of Scientific Certainty

So I would like, in the space available for comment, to say something about the inner nature of science and technology and of scientists and engineers—something which must be understood by all the world if we are to operate practically in the condition of moral unneutrality that has been invoked. These inner qualities really turn out to be special limits on science and technology. To state it baldly, scientifically there are limits on truth, there are limits on certainty, and there are limits on discovery itself. Maybe the limit on certainty is the most important to explore here. Scientific findings, scientific facts, are usually thought of as symbols of certainty. But people must realize that these findings are certain only with respect to a particular frame of reference. That frame of reference is, broadly, the present state of knowledge or the present position of scientific thought. Richard Feynman put this eloquently in a lecture on the value of science, delivered in 1955. He said, "We have found it of paramount importance that in order to progress we must recognize the ignorance and leave room for doubt. Scientific knowledge is a body of statements of varying degrees of certainty—some most unsure, some nearly sure, none *absolutely* certain . . . . Now we scientists are used to this, and we take it for granted that it is perfectly consistent to be unsure—that it is possible to live and *not* know." And so the world, facing the possibility of an era blessed by the fruits of science, as Sir Charles points out, must learn to accept the uncertainties of science.

Correspondingly, the truth is also subject to drastic revision in the light of discovery. Note carefully the difference between this kind of revision of "truth" and that in which the truth is compared to falsehood, deceit, or clumsy human error. Indeed, since wave mechanics has

supplemented classical mechanics in the description of material events, the scientists' own concepts of truth and certainty have dramatically changed. But much of the *popular* view of science is still related to the deterministic description of the state of a physical system. Technically, this reached its climax in Newton's revelation of the basis of Kepler's laws governing the motion of the heavenly bodies. However, in atomic physics this causal deterministic account has been vigorously displaced by the quantum theory, involving a universal quantum of action. Thus, for nearly 60 years the physicist, and later the chemist, have had to make experimental conditions such that they could describe universally their findings without being dependent upon a particular quantum which was being observed at that particular time. In other words, to make these experiments anything like a truthful description, we have had to work with such heavy-handed measurements that the individual quanta of action were completely disregarded. However, in doing this we threw away the old-time goal of certainty of position in time or in space, and thus a certainty of movement too.

Hence, in a quite technical way, but with an abiding philosophical meaning, the scientists of our age and also the engineers who work with nuclear physics and with the tools of solid-state electronics, like transistors and magnets, have already come to terms with the kind of uncertainty and incomplete truth with which they must live. But, along with this, of course, there is a quantization of truth. Never can the scientist deal with a half truth, even though it may resemble that fragment of Irish confetti called a "half brick" in that both are said sometimes to carry further than the whole. The scientist has to tell the whole truth as he knows it in that moment in time, and nothing less or different can be expected. The situation relative to detection of underground nuclear explosions vividly illustrates this.

Science and Compromise

This brings us to some other large limitations in the tactics of science with respect to their harmonious integration in human affairs. For instance, that esteemed virtue of some of the noblest leaders of societies and of nations, the ability to compromise, is painfully, utterly lacking in the scientist producing new science. My late colleague Karl Jansky had powerful reasons for regarding the sibilant murmurs of his radio research antennas as some earthborn interference. This would have been just the sensible thing to decide on and allow for in the decisions on power and frequency then shaping up for long-distance radio usage. But the refusal of any researcher to compromise the possibilities led Jansky to the discovery of radio astronomy through radiation from the stars. Likewise, we cannot say that we will make an international agreement defining the correct amino acid sequence in the helix of a protein-nucleic acid molecule, convenient as that might be. In contrast, of course, we do make just such agreements about the gold value of the dollar, about international law, even about the time of day. Is it not well that science warns that all cannot be compromised? George Orwell, in *1984*, warns grimly about such deep danger to human freedom: "For it is only by reconciling contradictions that power can be retained infinitely."

Discovery and Individuality

Finally, concerning the limitations on discovery, here we must respond to the popular queries, Why don't the scientists do the things we need to have done —why isn't there a cure for cancer now, why don't we have a defense against nuclear weapons, why cannot we make more reliable moon rockets, why don't we understand the forecasting of weather? Thus, on and on, the infinity of unanswered questions flows, and as long as the human race advances, so will it ever flow. The point is that the scientist does not really know how to multiply—or perhaps one might better say to distribute—his efforts. It is not useful for a team of 100 scientists each to have one one-hundredth of a good idea. No one ever synthesized an important new idea in science that way. The ideas of scientific discovery come one at a time from one person and one mind at a time. Sometimes two or three can aid each other. But scientific discovery cannot be collectivized, and it does not flourish in collectivized structures. As Sir Charles has said, individuality, independence, scientific nonconformity are the requisites for discovery.

Even then, how hard and slow it is. Take the case of light—the mystery and adornment of the universe since the Creation: "Let there be light!" Thousands of scientists have studied it, in tens of thousands of ways. But only this year was the concept of coherent light —light whose waves start and go from a source in unison—realized in the optical maser. Thus, Schawlow and Townes envisioned, and there has been achieved, light never before beheld. This is past the halfway point of the 20th century —what else, indeed, have scientists not beheld? All these things too, I hope, the people will understand and will have sympathy for, when science has the operational role for which Sir Charles Snow petitions.

Altogether, then, I ask that scientists be trusted mightily in view of the changes, the revisions, the alterations that they will constantly have to make in their role in large human affairs. In the small, they do almost universally trust each other, as Sir Charles has brought out so eloquently in his novels, even by dramatizing the rare cases of mistrust. The experiences of many decades now have shown that this trust is merited and does good. When the trust has been sufficiently enlarged, neutral scientific moralisms will diminish and disappear. And the natural scientist will once more call on the poet (Wordsworth) to say that, in the end, science belongs to all, not part, of man:

> . . . For I have learned
> To look on nature, not as in the hour
> Of thoughtless youth; but hearing oftentimes
> The still, sad music of humanity,
> Nor harsh nor grating, though of ample power
> To chasten and subdue. And I have felt
> A presence that disturbs me with the joy
> Of elevated thoughts; a sense sublime,
> Of something far more deeply interfused,
> Whose dwelling is the light of setting suns,
> And the round ocean and the living air,
> And the blue sky, and in the mind of man. . . ."

Science in the News

Inauguration Week: Ike's Farewell Address; Reorganizing the AEC; Rules Committee Maneuvers

The prestige of science reached a new height of sorts last week as the retiring President, in his farewell address, warned the country to guard against unwarranted influence by two groups: "the military-industrial complex" and a "scientific-technological elite." His point was that the country is spending more than half the federal budget on the military and that half the scientific research in the country is being underwritten in the name of national security.

The enormous amounts of money being spent naturally give power to the military, industrial, and scientific authorities who handle the work, power that is accentuated both by the need to turn to those who are given the money to spend for the necessary expert advice on *how* it should be spent, and because of the ability of these groups to appeal over the heads of their legal superiors to Congress and to the public, always in the name of national security, for more power and more money. (In his press conference the next day Eisenhower cited the example of the expensive, full page ads he was seeing everywhere, designed to build up support for this or that expensive missile or other research and development project.)

This interpretation, suggested by members of his staff, emphasizes Eisenhower's concern about scientists as a part of what has come to be known as the "defense lobby," actually a complex of lobbies insisting that one thing or another is necessary for national security and adding up to general pressure to increase spending above whatever it might happen to be at the moment.

Eisenhower's warning was regarded as worth while by a good many people in Washington who disagree with his philosophy of government, but they were thinking of something different from what the retiring president had in mind.

Eisenhower has been widely criticized, of course, for his reluctance to increase federal support for one area or another, but particularly science, education, and defense, and these criticisms, although reaching their widest audience through the voices of his political and journalistic critics, have been based largely on what "the experts"—scientific, educational, or military—have insisted was necessary in the interests of national security.

This was an annoying situation for Eisenhower; for although it was getting increasingly hard to argue with the experts, to accept their views implied that it would be necessary to abandon his firmly set beliefs in keeping government as small as possible and in resisting further government interference in the free enterprise economy. He was naturally worried about this "military-industrial complex," this "scientific-technological elite" that would, it seemed to him, if given a free hand, change American society into something quite different from the society he had known and believed in.

Mood of the Farewell

The pressure of the arguments from this "elite" led him to endorse the recent paper of his Science Advisory Committee that explicitly put "primary responsibility" for advanced scientific education and for basic research on the federal government, but his heart was not in it. There were scant signs that this sort of thinking influenced his final budget, and his misgivings showed up in the warning in his farewell address of "the prospect of domination of the nation's scholars by federal employment, project allocations, and the power of [federal] money."

The farewell address, more eloquent and moving than any speech he had given in a long time, expressed the feelings of a man who deeply felt he had served the country well in resisting the forces of a change toward stronger and bigger central government, about to retire in favor of a man who seemed to go out of his way to identify himself with those forces. He said later that the farewell was the last speech he would make, and he wished Kennedy well, but it is doubtful that he will find himself able to remain silent for very long. The farewell warnings are likely to be repeated.

But the mood of Washington, reflected in the eagerness with which the city awaited Kennedy's assumption of power, was not with Eisenhower. There was a good deal of support for Walter Lippmann's assertion that Eisenhower was "out of date." The Kennedy people are concerned about the defense lobby not so much as a lobby for more spending, for they are for more spending, but as a conglomeration of lobbies, each demanding support for its pet projects. The problem of the President, in this situation, is to assert domination in order to see that the money is spent and the effort is organized as the national interest demands, not as several dozen competing groups, each made up of an assortment of military, bureaucratic, industrial, scientific, and political figures would try to have it spent based on each group's belief, from its special point of view, that its interests are synonymous with the national interest.

The Kennedy people do not expect to be wholly successful, but they criticize Eisenhower for failing to offer strong enough leadership to be nearly as successful as he could have been. We will get a chance to see what Kennedy can do when he tackles the problem of the space and missile effort, which everyone complains is being mismanaged through the lack of strong leadership, and which will probably provide the new Administration with its first test of strength with the assorted interests of the defense lobby.

Reorganizing the AEC

During the week it became known that there would probably be fairly prompt action on another, less controversial, problem of organization. For several years now there have been complaints about the dual role of the Atomic Energy Commission as both

promoter of civilian uses of atomic energy and as a regulatory agency supposed to prevent uses of atomic energy where undue hazards might be involved. The critics have pointed out, and the AEC has agreed, that there is a built-in conflict of interest within the AEC as it tries both to speed up civilian use of the atom and to slow it down to protect the public safety.

Proposal for New Agency

Such apparently conflicting interests as the United Auto Workers, which feels its people are being endangered, and the Detroit Edison Company, which is building a plant, have both come out for setting up a separate agency to handle the regulatory functions. But Chet Holifield of California, the new chairman of the Joint Congressional Committee on Atomic Energy, and a supporter of strict regulation, has recently said he did not see where a separate regulatory agency was likely for several more years. The basic argument against a separate agency has been, and continues to be, that even though a separate agency may be desirable in theory, as a practical matter only the AEC now has the expertise to handle the job.

But aside from this, not many people are interested in setting up still another regulatory agency at a time when most of those that exist are being criticized as inefficient, too subject to influence by the people they are supposed to regulate, and in some cases, such as the Federal Communications Commission and the Federal Power Commission, virtually incompetent to handle their jobs.

The AEC has now come up with a compromise plan which would separate the regulatory functions from the rest of the agency, with the chief regulatory officer reporting directly to the five commissioners. The AEC general manager, who now has over-all supervision of all activities, will no longer have any control over the regulatory side of the agency. The planned changes have general support within the AEC and with the Joint Committee and apparently will be put into effect promptly unless Glenn T. Seaborg, the new chairman appointed by Kennedy last week, disapproves.

Reaction to Seaborg

Seaborg's appointment, incidentally, received an unenthusiastic response from the joint committee, primarily because he was not well known to the committee, but partly on the grounds that a scientist would soon find himself fed up with the involved politics of the AEC. Some of the committee staff were prepared to put a little money on the proposition that he would not last out the year.

But Seaborg has been serving as chancellor of the University of California, and presumably has already gotten more than a taste of political infighting, although perhaps that is not enough to prepare a man for the Washington jungle. Seaborg has also been serving on the Science Advisory Committee, but that group, to the considerable annoyance of Congress, has been pretty well shielded from Washington politics by their status as confidential advisers to the President.

Rules Committee

Meanwhile it was widely, although not universally, assumed that Sam Rayburn, the Speaker of the House, had assured the reform of the House Rules Committee, which in the past has served as a burying ground for the type of legislation that Kennedy will need.

The final results should be known by the time this appears. But well before the vote was scheduled a leader of the liberal bloc in the House was exuding both confidence that Rayburn would succeed and admiration for Rayburn as a master of political strategy. The source has been a member of Congress for nearly 20 years, but he could always learn something new from Mr. Sam, he said, and this time he had learned a lesson about the importance of timing in the art of politics.

It had been assumed that Rayburn would try to take control of the Rules Committee away from Howard Smith and his ultraconservative coalition either by pushing through a rule to enlarge the committee on opening day, when the House adopts its rules for the session, or by purging William Colmer of Mississippi when the House Democrats nominated their committee members.

To try to change the rules after opening day seemed especially difficult, for then the rules change would have to go through the Rules Committee in order to reach a vote on the floor, and it hardly seemed likely that the conservative coalition on the committee could be persuaded to assist in its own demise.

In fact, though, this unlikely situation was guaranteed last week when Judge Smith publicly pledged himself not to block the rules change that would take control of the committee away from him. He did so after Rayburn had convinced him that if he failed to make the commitment Colmer would be purged, an alternative which the Judge decided was slightly more distasteful than packing the committee.

The advantages of Rayburn's tactics, his admirers say, were that they gave him time to solidify support for the change among conservative Southerners and thus to diminish the risk that enough conservative Democrats would join with conservative Republicans to defeat the proposal; that by making it clear that he was in a position to purge Colmer he was able to make the alternative of merely packing the committee appear to be a conciliatory compromise by comparison, thus getting done what needed to be done while arousing a minimum of hard feeling among people whose cooperation would be needed later in the session; and that, finally, by putting off the debate over the rules change until some time after opening day he had prevented the headlines about the convening of the new Congress from being dominated by an intraparty squabble among the Democrats.

By the time the Democrats met last week to take a position on the rules change, Rayburn had gotten enough support that Judge Smith conceded "I know when I'm beaten," and most of the Southerners who might have supported Smith sat passively silent while a voice vote in the caucus endorsed the change. A Republican caucus later went on record asking its members to oppose the rules change, but there were enough liberal Republicans who intended to vote for the change to make defeat of the proposal unlikely, although not unthinkable.

The expected success of the rules change also suggested something about the power of a strong president. The reform would have to go through despite the weakening of liberal forces in the House in the past election. But with Kennedy in the White House Rayburn could, and apparently did, persuade a few recalcitrants to go along by reminding them that if they failed to go along "you'll not only be on my list, you'll be on the list of someone higher up." He used a blunt four-letter word to characterize the type of list he had in mind.—H.M.

News Notes

European Governments Plan Cooperative Space Research

Britain and France are sponsoring an international space conference on 30 January in Strasbourg in the hope of developing a cooperative European research program. The governments that have been invited to participate in the meeting, which will be led by British Minister of Aviation Peter Thorneycroft, include Austria, Belgium, Denmark, West Germany, Italy, the Netherlands, Norway, Spain, Sweden, and Switzerland.

The immediate objective of the proposed joint project is development of a European satellite launching vehicle from the French Veronique rocket and the British Blue Streak. The latter was recently abandoned as a military weapon, but research on it as a satellite launcher has continued at a cost of about £1 million ($2,800,000) a month.

Another European Space Program

Another program for European cooperation in space was launched last month at the European Organization for Nuclear Research (CERN) in Meyrin, Switzerland. On 1 December, after a 4-day intergovernmental conference at CERN, an agreement for setting up a preparatory commission to establish a European Organization for Space Research was signed by nine of the ten countries invited, as well as by Spain, which was admitted as a member state during the conference after having taken part in its work as an observer. The other participating countries were Belgium, Denmark, France, Great Britain, Italy, the Netherlands, Norway, Sweden, Switzerland, and the Federal Republic of Germany. (The West German delegation did not have the authority to sign the agreement at the time of the meeting.)

At present three groups of scientists are working on the technical, administrative, and financial requirements of the new organization, which may be formed this summer and functioning by fall.

Space Symposium Planned

Still another event in European space activities was announced recently when the British Interplanetary Society reported that it is planning the First European Symposium on Space Technology. The meeting will take place in London, 26–28 June. Engineers and scientists from Western European countries, primarily those that are members of the Organization for European Economic Cooperation, will attend the symposium.

AEC Reports Status of Idaho Accident Investigation

Investigation into the cause of the 3 January accident at the Stationary Low Power Reactor No. 1 (SL-1) in Idaho continues to be slow and difficult because of extremely high radiation levels in the reactor building which impede efforts to obtain reliable data from instrumentation or visual observation as to the present conditions within the reactor itself. However, it has now been established that the reactor, located at the Atomic Energy Commission's National Reactor Testing Station near Idaho Falls, sustained an uncontrolled nuclear reaction.

Three men were killed in the accident, the first fatal accident in the history of U.S. reactor operation. The reactor is of conventional design and had been in operation for about 2¼ years. Two of the fatally injured men were certified reactor operators, and the third was a trainee scheduled to receive his certification next month. The men who were fatally injured were the only ones in the building.

So far as can be determined, a nuclear reaction is not going on in the reactor at this time, but it has not been possible to make a complete examination. Investigation of the reactor will, of course, be conducted cautiously to guard against the remote possibility that the investigation itself could initiate a nuclear reaction.

Concrete shielding blocks surrounding the top of the reactor prevent study from outside the building. However, an attempt will be made to examine the interior through nozzle openings or ports in the metal plate which covers the reactor vessel. Until the interior condition of the reactor is known, it cannot be determined with certainty what steps must be taken. Shielded television and photography appear to be the best methods of obtaining the initial information needed.

Aerial and ground monitoring continues to affirm that airborne radioactivity is being confined largely to the reactor building and the immediate vicinity. Direct radiation from the reactor building has shown no increase since the accident. Calculations from direct radiation readings are as follows: 1.1 r/hr at 100 ft; 0.037 r/hr at 500 ft; 0.009 r/hr at 1000 ft; and 0.002 r/hr at 2000 ft.

Cole Assesses International Atomic Agency's Progress

Sterling Cole, director general of the International Atomic Energy Agency, recently told the Atomic Industrial Forum in San Francisco that "none of us has been completely happy or satisfied with the agency's progress." Weak support from member governments, coupled with unstable financing, has reflected current international political tensions.

Nevertheless, Cole's annual report on IAEA to the United Nations General Assembly was on the whole encouraging. He indicated that today's assessment of nuclear power prospects is "generally more optimistic" than that of 2 years ago, although the production of cheap electricity, motive power, and heat from nuclear fuels "still remains to most countries a prospect for the future rather than a reality for the present." At present "the cost of nuclear power is falling quite fast, faster than that of conventional power, but from a greater height"; it is unlikely that the two curves will intersect until the latter part of the 1960's. The use of isotopes and radiation, on the other hand, continues to flourish and expand, and the agency is "beginning to see the first fruits of its own work in spreading this technology to the less developed areas," Cole said.

He pointed out that the "disappointment of earlier expectations" had influenced the development of the agency's work, noting that some nations had not used the agency as a clearinghouse for supplying atomic facilities and fuels to other countries, preferring separate agreements. As a result, the agency's program has been devoted to training and technical assistance, research and surveys, scientific meetings and publications, the elaboration of safety codes and regulations, and other preparatory and regulatory work.

Progress Described

Cole said that in these fields the progress made by the agency in the past year had been "positive and con-

siderable," and he gave some examples: some 420 fellowships were granted in the last year, to make a total of 1000 since the program started; experts and equipment were made available to atomic programs in 27 countries; 31 scientific reports were published; the first issue of the agency's journal on nuclear fusion research was published; draft conventions were elaborated governing the civil liability of operators of both land-based and nuclear-ship reactors; regulations for the transport of radioactive materials were drawn up and approved; technical recommendations for the disposal of radioactive wastes were worked out by a group of highly qualified specialists; and nine scientific meetings were held, attended by more than 2000 scientists from 40 countries.

The director general also reported on the "growing willingness of governments to place specialized facilities at the agency's disposal." He mentioned as examples the dosimetry experiment at Vinca, made possible through the cooperative attitude of the Yugoslav authorities and carried out with assistance from France, the United States, and the United Kingdom; the United Arab Republic's offer to convert its national isotope center to a regional center under the agency's aegis; Monaco's offer to make research facilities at the Oceanographic Institute available to the agency and to permit use of its research vessels; and the use of a reactor facility in Norway for a joint reactor physics research program.

Cole described the agency's function to establish and administer safeguards as "complementary to that of the United Nations in the field of atomic energy." He also referred to the services the agency is rendering the United Nations Scientific Committee on the Effects of Radiation on Man by performing analyses in its laboratory and by providing information on radiation protection problems.

Financing Improved But Inadequate

He termed the last session of the IAEA General Conference, held in Vienna in September, "the most constructive and encouraging conference that we have had since the agency was set up a little more than three years ago" and said that the fact that the conference had approved a substantial increase in the target for voluntary contributions to finance the technical assistance and laboratory activities of the agency showed that it shared his satisfaction over recent progress and his confidence in the agency's growing program.

However, he urged that a more stable basis be found for financing the agency's technical assistance work. The voluntary contributions upon which technical aid is dependent "consistently are insufficient" to meet the objectives set up by the various governments.

Livingston Compares Disarmament and Arms Control; Prods Federation of American Scientists on Policy

M. Stanley Livingston of Massachusetts Institute of Technology, chairman of the Federation of American Scientists, discusses "Disarmament and/or Arms Control and FAS Policy" in the federation's January newsletter. Excerpts from his statement follow.

Advocacy of disarmament is becoming respectable. . . . General agreement on the necessity for some arms control is one of the most significant consequences of the development of nuclear weapons. . . .

[However,] there is wide disagreement on the general formulas for disarmament, and also on the many competitive proposals for a "first step." But there is also serious disagreement on the ultimate goal, which can be characterized by the meanings implied in use of the two terms: "disarmament" and "arms control."

Both terms are used (or misused) by individuals whose philosophies are widely different. Enthusiasts for immediate total disarmament of all national military forces down to police levels conceive this goal to be the only true disarmament. . . .

Others believe that real disarmament means the ultimate elimination of all weapons of mass destructions, but expect it to take a long time and to be accomplished only by many successive small steps. . . . They use the term "arms control" to describe the successive steps and agreements; to them it is the means to the end, but not the goal.

A very much larger number conceive of "arms control" itself as the ultimate goal. To them the maintenance of national military force is essential for national security. "Arms control" means a delicate balance in number and type of national armaments designed to minimize the incentives for other countries to initiate a war. Basically, it is nothing more than military strategy in modern dress, and the international agreements for which they plan are those which would improve their own country's capacity for deterrence. Unfortunately, these spokesmen are only too willing to use the term "disarmament" as a facade to conceal their purpose and to gain public acceptance of their policies. . . .

FAS and National Policy

The FAS has wavered uncertainly in accepting responsibility for formulating a disarmament policy. Despite the efforts of a few dedicated individuals all attempts to formulate a policy acceptable to the Council have degenerated into almost meaningless generalizations. This is an untenable position for a political action group representing the opinion of socially conscious scientists. It is past time for the FAS to state its policies clearly and with force.

The FAS policy must be long-range, and must firmly set forth the ultimate goal; it should be flexible enough to allow a wide variety of first-step approaches, but should not attempt to formulate each step in the process. It should distinguish clearly between arms control and true disarmament, and should accept arms control proposals only as a means to the end. It should emphasize the ultimate necessity of international inspection and control under a world of law. In this policy the FAS should not attempt to design a step-by-step disarmament program, nor should it try to formulate compromises between realists and idealists. The need is for a forthright and idealistic statement of the ultimate goals, to supply the leverage for our country to move steadily closer to these goals.

Policy Statement Proposed

In order to start discussion and stimulate others in formulating a policy position for the FAS on disarmament and arms control, I suggest the following statement for FAS consideration:

"The Federation of American Scientists strongly supports the policy of comprehensive disarmament of all weapons of mass destruction, under a world of law with an international police force to provide inspection and control. Nothing less can be acceptable to anyone with a decent respect for mankind. In working toward this goal a massive effort is required to understand and evaluate the many economic, tech-

nical and political factors which lead to international misunderstandings and strife. We urge our government to stimulate and support a greatly expanded program of study of these factors, one which is commensurate with the scope and urgency of the problems involved. Specifically, we propose detailed analyses of the technical problems of systems of inspection and enforcement of disarmament agreements, and of their effectiveness and cost. We advocate international negotiations to clarify areas of concern, and distrust, and to formulate plans to remove or minimize legitimate sources of distrust. We advise our government to act quickly in several areas where agreements are potentially within reach, in order to test the sincerity of ourselves and other nations; we advise this even if it involves some short-term risks of unbalance of military deterrents. We believe that some risk is justified in view of the greater risk of failing to act. We consider such arms control agreements to be justified only if they lead to further and more meaningful disarmament agreements, and only if they are adopted as a part of a conscious effort to decrease the chance of uninhibited armed conflict. We recognize the need to build confidence in the United Nations as a forum for the discussions of international problems, and to strengthen the authority of the international police force in neutralizing aggressions. Above all we urge that the ultimate goal of true disarmament under a world of law be made the real, as well as the ideal, purpose of U.S. policy."

News Briefs

Biophysics placement service. The Biophysical Society will operate its placement service at the fifth Annual Meeting, to be held at the Chase Hotel, St. Louis, Mo., 15–18 February. This service will be available to registrants without charge. Rooms for interviews will be provided. Further information and forms for registration by prospective employers and candidates prior to the meetings may be obtained by writing: Biophysical Society Placement Service, Box 668, Frederick, Md.

* * *

Epidemiological board. The Armed Forces Epidemiological Board celebrated its 20th anniversary on 11 January. The board, consisting of top civilian medical scientists who serve on 12 commissions, was originally established in 1941 to advise the Army, and later the other military medical services, on preventive medicine problems of military importance. President of the board is Gustave J. Dammin, professor of pathology at Harvard Medical School. Col. John Rizzolo, USAF, MC, is executive secretary.

* * *

Parasitologists organize. The International Federation of Parasitologists is being organized from headquarters at the University of Illinois. Francis J. Kruidenier, University of Illinois zoologist, is secretary of the initial governing commission and executive committee. T. W. M. Cameron of McDonald College, Canada, is executive committee chairman.

The federation will include workers in medical, veterinary, and biological fields. It will consist of affiliated societies and individuals and will extend throughout the world, including scientists of both Eastern and Western countries. It hopes to work through the World Health Organization, serving as an international study group. Federation plans grew out of the first International Conference on Trichinosis, held in Warsaw in September under sponsorship of the Polish Society of Parasitology.

* * *

Gerontological journal. The Gerontological Society, Inc., has authorized publication of a new quarterly journal to be known as *The Gerontologist*. It will be similar in format to the *Journal of Gerontology*. Publication will begin in 1961. The new publication will feature review articles, theoretical articles, historical articles, and articles dealing with current action programs. A dozen countries will be represented on the editorial board, emphasizing the international character of the enterprise. Oscar J. Kaplan, San Diego State College, San Diego 15, Calif., will serve as editor-in-chief. Manuscripts should be sent to him for consideration by the editorial board.

* * *

Chinese scientific material. The Consultants Bureau, New York, has announced that it is planning to translate and publish selected Chinese scientific articles. During 1961 the program will cover from 500 to 1000 pages of highly specialized material in the fields of chemistry, physics, biology, earth sciences, mathematics, and metallurgy.

Grants, Fellowships, and Awards

Atomic energy. The Atomic Energy Commission will sponsor a summer institute in nuclear physics and atomic energy especially designed for members of the faculties of small colleges. To be conducted from 26 June to 18 August by the Oak Ridge Institute of Nuclear Studies in cooperation with Oak Ridge National Laboratory, the institute will give 20 participants an opportunity to learn or review basic nuclear-energy concepts, acquire an understanding of the current nuclear-energy developments, become familiar with nuclear equipment, and gain insight into the development of college courses in the field. Further information and application blanks are available from the Atomic Energy Institute, University Relations Division, Oak Ridge Institute of Nuclear Studies, P.O. Box 117, Oak Ridge, Tenn.

Geology. An international field institute for geology teachers in U.S. colleges will be held in Great Britain during the summer of 1961. It is sponsored by the American Geological Institute, under a grant from the National Science Foundation that will provide travel and subsistence allowances for participants. The purpose of the 8-week summer program is to permit 20 teachers of geology at the college and university level to become familiar, in the field, with classic geologic areas of Wales, northern Ireland, Scotland, and the south coast of England, under the leadership of recognized British geological scientists. Directors of the institute program for AGI will be Frank H. T. Rhodes, University College of Swansea, Wales, and Paul R. Shaffer, University of Illinois.

Applications must be filed *before 15 February*. Inquiries should be addressed to Professor Paul R. Shaffer, AGI International Field Institute–1961, c/o Department of Geology, University of Illinois, Urbana, Ill.

Southeast Asia. For the fifth consecutive year, the Southeast Asia Treaty Organization is offering a number of postdoctoral research fellowships to established scholars of the member states. The object of the fellowship program is to encourage study that will give insight into the present needs and future development of the Southeast Asia and Southwest Pacific areas.

Grants are normally made for a period of from 4 to 10 months and include a monthly allowance of $400 and

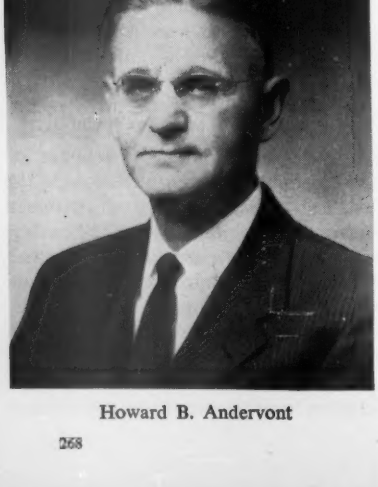
allowance for air travel to and from the countries of research. The competition for the awards for the 1961–62 academic year is now open. United States citizens may apply to the Executive Committee on International Exchange of Persons, Conference Board of Associated Research Councils, 2101 Constitution Ave., NW, Washington 25, D.C. This country's candidates for the awards are nominated by the Department of State; SEATO selects the final award winners.

Scientists in the News

Howard B. Andervont, a member of the original research staff of the National Cancer Institute and a former president of the American Association for Cancer Research, has relinquished his duties as chief of the institute's Laboratory of Biology. Although eligible for retirement, he will continue his research in the laboratory he has headed for 15 years. Supervisory responsibility has been assigned to **Walter E. Heston** as acting chief.

Andervont has also been appointed scientific editor of the *Journal of the National Cancer Institute*. In this capacity he succeeds **Michael B. Shimkin**, who was recently named the institute's associate director for field studies.

Andervont's career in cancer research for the U.S. Public Health Service began with his appointment 30 years ago as the biologist of the first cancer research group established by the Service. As one of the pioneers in recognizing the importance of studying the viral etiology of cancer and the use of inbred animals in cancer research, Andervont has made noteworthy contributions in studies of the Rous sarcoma virus in fowl and the Bittner mammary tumor virus in mice. By feeding animals milk containing the Bittner agent, through foster-nursing, he converted a strain of mice that seldom developed mammary tumors to one with a high incidence of such tumors.



Howard B. Andervont

Through research in chemical carcinogenesis, Andervont showed that the nature and duration of carcinogenic stimuli influence the biological properties of cancer. In studies of the role of hormones in the development of cancer, he demonstrated that some tumors may progress from hormone-dependence to autonomy.

Sir **George Thomson**, master of Corpus Christi College, Cambridge, is making a lecture tour in the United States under the auspices of British Information Services. His talks are on the general theme of the relation between pure and applied science.

W. N. Aldridge of Great Britain, a member of the Medical Research Council's staff at the Toxicology Research Unit in Carshalton, Surrey, is spending 2 months in the department of physiological chemistry at the University of Wisconsin, Madison.

Irving A. Taylor, senior research associate and project coordinator in the Institute for Developmental Studies at New York Medical College, has accepted the position of associate director of research at Nowland and Co., Greenwich, Conn., effective 1 February.

Ralph Feder, physicist, of the Physics Research Laboratory, Pitman-Dunn Laboratories Group, Frankford Arsenal, will spend the next 5 months in Argentina, where he will assist Jorge Sabato, head of the Metallurgy Division of the Argentine Atomic Energy Commission, in setting up an x-ray diffraction laboratory and organizing groups to work on several phases of a project on niobium.

M. A. Joslyn, professor of food technology, University of California, Berkeley, has resumed his research and teaching activities. Joslyn has been absent on an extended leave since July 1958. He served as food processing adviser to the Israeli Ministry of Commerce and Industry for a year and then spent his sabbatical traveling in Europe, working at the Institute of Agricultural Chemistry of the Eidgenosische Technische Hochscule in Zurich, and serving, for a term, as visiting professor of food technology at Massachusetts Institute of Technology.

Thomas J. King, former head of the department of embryology of the Institute for Cancer Research, Philadelphia, will receive a Fordham College Alumni Association Award at the association's 107th annual dinner on 2 February at the Waldorf-Astoria Hotel, New York.

Recent Deaths

Howard W. Ambruster, Fanwood, N.J.; 82; chemical engineer, writer, and lecturer, who spent a lifetime fighting for the strict enforcement of pure food and drug laws and opposing the international chemical trusts; 10 Jan.

Norman R. Blatherwick, Daytona Beach, Fla.; 72; retired in 1950 as director of the New York biochemical laboratory of the Metropolitan Life Insurance Company, a position he had held for 23 years; is said to have been the first U.S. research scientist to synthesize insulin; 13 Jan.

George H. Bretnall, Shepherdstown, W. Va.; 89; retired professor of biology at Shepherd College, where he had headed the biology department; 10 Jan.

Worth Hale, Hampden, Mass.; 84; associate professor emeritus of pharmacology and former assistant dean for admissions of the Harvard Medical School; 16 Jan.

Chevalier L. Jackson, Philadelphia, Pa.; 60; co-founder, with his late father, of Temple University Hospital's bronchoscopic clinic, which he headed; professor and chairman of the department of laryngology and bronchoesophagology at the Temple School of Medicine; 13 Jan.

Frederick W. Sinn, Sr., Philadelphia, Pa.; 48; head of the department of optics at Pennsylvania State College of Optometry; 11 Jan.

Ralph G. VanName, White Plains, N.Y.; 83; professor emeritus of chemistry at Yale University; 4 Jan.

Harlan H. York, Montgomery, Ala.; 85; taught botany at Brown University, the University of West Virginia, the University of Pennsylvania, and the University of Massachusetts (Fort Devens) and was forest pathologist in the U.S. Department of Agriculture, New York Conservation Department, and Alabama Division of Forestry; 7 Jan.

Book Reviews

Thought Reform of the Chinese Intellectuals. Theodore H. E. Chen. Hong Kong University Press; Oxford University Press, New York, 1960. xiii + 247 pp. $5.

The Hundred Flowers Campaign and the Chinese Intellectuals. Roderick MacFarquhar. Epilogue by C. F. Hudson. Praeger, New York, 1960. xii + 324 pp. $6.75.

These two books are largely complementary. Theodore Chen discusses the plight of the Chinese intellectuals under Chinese communist rule for the whole period from 1949 to 1958, while the greater part of Roderick MacFarquhar's book consists of extracts from the material that appeared during the short period of comparative freedom in 1957.

Chen begins by considering the underlying Chinese communist attitude toward intellectuals—on the one hand, realization of their influence in Chinese society and of the importance of winning their support and, on the other, a determination to enforce conformity in thought and complete acceptance of party authority.

When the Chinese Communist Party came to full power in 1949, it had general support from a considerable proportion of the intellectuals who, however, were still far too independent and critical in their thinking to satisfy the communist leadership. A large-scale program of indoctrination through special study groups was started in which the intellectuals were supposed to realize the importance of reforming their thoughts and of repudiating the poisonous influences of their bourgeois background and of the American contacts which had been a major influence in Chinese universities and schools before 1949. The indoctrination was made more concrete by demands for participation in such activities as the land reform campaign and the "Resist-America, Aid Korea" movement; for public confessions repudiating past influences and pledging loyalty to the Communist Party and the principles of Marx-Leninism; and by the selection, for special attack, of persons considered typical of viewpoints which the Chinese Communist Party considered erroneous, but whom many intellectuals had respected. Among these personal targets was Wu Hsun, a 19th-century educational reformer who, coming from a poor family, had devoted his life to starting schools. As late as 1950 even communist publications had praised Wu Hsun, and a film about his life was released in December 1950. In 1951, however, he was selected as being typical of those who lacked class consciousness and who had failed to attack the culture of feudal society, and he was denounced as "villainous, feudalistic and anti-people." Other special targets of attack included Hu Shih (denounced for his erroneous philosophy of pragmatism and his subservience to America), J. Leighton Stuart (as typical of American cultural imperialism), and the agrarian reformer Liang Shu-ming (as typical of non-Marxist reformism).

Pressure was intensified with the campaigns against counterrevolutionaries and with the campaign in 1955 against Hu Feng, a writer who had been sympathetic to the communists but critical of party control of literature and art; in the latter campaign many other intellectuals were denounced as being members of a Hu Feng clique. Chen cites several instances showing how much intellectuals were at the mercy of domineering party cadres.

By 1956 the communist leaders seem to have realized that their pressure on the intellectuals had been carried to a point which seriously reduced the intellectuals' working efficiency. In January 1956 a conference was called to discuss "The Problem of the Intellectuals." Chou En-lai made a speech in which he admitted that there had been shortcomings in the treatment of intellectuals and that they had not been given the opportunity to make their full contribution to the new society. Improvements were made in living conditions and in library facilities, and the load of meetings and administrative work was reduced. Beginnings were made in some relaxation of controls, and more intellectuals were admitted to the Communist Party.

The Hundred Flowers Campaign

The slogan "Let a hundred flowers blossom together; let a hundred schools of thought contend" seems first to have been announced by Mao Tse-tung in an unpublished speech at the beginning of May 1956, and it was the title of a speech by Lu Ting-yi at the end of May. Lu stressed that this new freedom of discussion was "a policy to strengthen unity" and that the campaigns against Hu Feng, Hu Shih, and Liang Shu-ming had paved the ground for it. Chou argues that the new policy followed from a realization that pressure alone had failed to secure sincere support from the intellectuals and that the party must use other means to win them over.

In the course of 1956 there was an appreciable relaxation of control over literature and academic study, but there was controversy over the limits of this greater freedom; some elements in the Communist Party disapproved of the new line in literature and had sufficient influence to secure publication of their criticisms of this freedom in leading newspapers and periodicals.

The next important development was the speech by Mao Tse-tung (27 February 1957) on "Contradictions among the People." This was not published until the middle of June, though it was given to an audience of 1800 in Peking and tape recordings of it were reproduced at meetings in other centers. MacFarquhar gives an interesting comparison between the version of the speech which was finally published and a version, obtained earlier in Poland, which was probably nearer the original. During March and April a series of forums was started in which the participants were encouraged to speak frankly and were promised freedom from reprisals.

Reasons for the New Policy

MacFarquhar rejects the view that Mao's policy was simply a trap to induce opponents of the regime to reveal themselves. He argues: "Probably it would be more correct to say that Mao was the victim of his own ideas and illusions. He really believed in the funda-

mental unity of the Chinese people and believed that the methods he had used had preserved this unity. He knew mistakes had been made; the whole object of the rectification campaign was to prevent their recurrence. But he firmly believed that the conventional Communist formula—often criticized during the 'Hundred Flowers' period—that achievements were primary and defects secondary really corresponded to the facts."

Neither author fully brings out a feature of the communist system which would have provided a strong motive for Mao's policy, if this view of his beliefs is correct. It is clear, even from official communist sources, that local cadres often abused their powers and created grievances which the leadership was willing to remedy when it found out about them and that, because of the suppression of criticism, it was often a very long time before the leadership did find out. If Mao believed that the communist system had been generally accepted and that the bulk of criticism would be directed against defects which the leadership was willing to correct, then he could, quite logically, conclude that freedom of criticism would actually strengthen the regime.

In fact, a great deal of the criticism attacked the basis of the communist system, and it came not only from the older intellectuals, which the communists could have explained away as the result of bourgeois background, but also from students, peasants and workers, and even from some Communist Party members of long standing. MacFarquhar gives a large sample of the criticisms which appeared, and Chou gives a summary with a number of quotations.

During May 1957, when people had found that it was possible to criticise without immediate reprisals, both the volume and the seriousness of criticism increased exponentially. At the beginning of June the Communist Party reacted with the "anti-rightest" campaign. The critics were attacked, dismissed from their positions, and forced to make new and humiliating confessions. The period of comparative freedom was followed by the strict enforcement of official orthodoxy and of complete subservience to the party and by the violent denunciations of revisionism, which have continued up to the present.

LINDSAY OF BIRKER
School of International Service, American University

General Theory of Banach Algebras. Charles E. Rickart Van Nostrand, New York, 1960. 405 pp. $10.50.

This book, as the title suggests, is entirely devoted to the general theory of Banach algebras. During the 1930's algebras of operators defined on a Hilbert space, that is, special Banach algebras, were extensively studied by von Neumann and Murray. The abstract definition of this concept was given by Nagumo in 1936. But it was not until 1941 that Gelfand, in an epoch-making article, laid the foundations for a general theory of Banach algebras. Gelfand's new approach consisted of the full use of the techniques of elementary ideal theory. In particular, the applications which Gelfand made of his theory to give elegant proofs of some very deep theorems of Wiener in the theory of Fourier series and the theory of Tauberian theorems attracted a great deal of attention. Moreover, Gelfand's applications established the usefulness of algebraic methods in certain areas of analysis.

The book under review consists of four chapters and an appendix. In chapter 1 ("Fundamentals," pages 1–38) the general definitions and notions of the theory are given. This chapter contains a detailed study of the motion of the spectrum of an element of a Banach algebra culminating in a simple proof (due to the author) of Gelfand and Mazur's theorem that a normed division algebra over the complex field is isomorphic to the complex field. The algebraic foundations of the theory are given in chapter 2 ("The radical, semi-simplicity and the structure spaces," pages 41–96). In this chapter the author presents a large amount of material that previously was available only in articles scattered in many periodicals. The theory presented in chapter 2 is applied in chapter 3 ("Commutative Banach algebras," pages 108–173) to obtain Gelfand's original theory of commutative Banach algebras. In addition to this, chapter 3 contains a detailed discussion of the theory of the Šilov boundary and of the theory of completely regular algebras. Algebras with involutions, such as algebras of bounded operators, are studied in chapter 4 ("Algebra with an involution," pages 178–260). This chapter contains Kaplansky's and Fukamiya's proof of Gelfand and Naimark's conjecture that every B*—algebra is symmetric. The author has refrained from giving a detailed account of the theory of special algebras, such as the von Neumann algebras, algebras of continuous functions, and group algebras because three books, each devoted to the general theory of one of these special algebras, have been published. However, a brief account of each theory is given in three separate paragraphs collected in the appendix. Since most of the details are omitted in this appendix, it may be looked upon as a source of exercises. A complete bibliography, containing more than 800 titles, concludes the book.

It is Rickart's belief that the development of the general theory of Banach algebras as an independent discipline is to be found in its algebraic development. In this respect the book, particularly in chapter 2, differs remarkably from its Russian counterpart, *Normed Rings* by Naimark (1956; English translation by L. Boron, 1959).

The style of Rickart's book is concise but precise, and those who have an appreciable knowledge of the elements of functional analysis and general ring theory will find that it is not too difficult to read.

The book is an important contribution to the existing literature on this subject; the author and the publisher are to be congratulated for publishing this excellent book.

W. A. J. LUXEMBURG
Department of Mathematics, California Institute of Technology

Principles of Human Genetics. Curt Stern. Freeman, San Francisco, ed. 2, 1960. x + 753 pp. Illus. $9.50.

For years it has been something of a cliché that man is an unfavorable subject for genetic studies. To be sure, one cannot deliberately plan crossing experiments with successive generations of human beings, as one can with, say, *Drosophila* flies; even if this were possible, the results would be too slow in coming for an experimenter to record them. Yet on the other hand, human materials offer advantages not found in any other material. Much historical information about human families is preserved in many places, from family chronicles to state archives; history has recorded nothing about *Drosophila* genetics. Human morphology and physiology are relatively well known. And more people are interested in man than in any other species; this makes possible greater expenditures of labor and funds

than could be made with anything else. Peas, evening primroses, and rodents were favorite materials with early geneticists; there followed about three decades of supremacy of *Drosophila*, an interlude of *Neurospora* mold, and finally bacteria and viruses. However, there are straws in the wind which seem to point toward human genetics coming next to the forefront.

The first edition of Stern's textbook of human genetics (1949) has become a classic in its field. It has no rival in lucidity, precision, objectivity, and fairness in the presentation of even highly abstruse matters. All these qualities are fully preserved in this second edition, which was necessitated by the remarkably rapid growth and progress in the field. Despite this growth, the volume of the book is only moderately increased—from 604 to 733 pages (excluding the index). The plan of the book remains the same, but we now have 33 chapters. The chapters which have new titles deal with linkage and crossing over, variations in the expression of genes, and the genetic hazards of radiation; two new chapters deal with heredity and environment and selection in civilization. Except in some of the early chapters, much new material has also been added in the chapters retaining their old titles. Altogether, this is not a patch-up job, so often found in new editions of textbooks, but a new and modern text.

Having written some books, I know from sad experience that to write one entirely without errors is superhuman; enough, therefore, to say that the book under review contains no important errors that I noticed. As to the general character of the book, it can be described as scientifically conservative, judicious, tending to adhere to classical lines and to avoid controversial issues. These qualities will appeal to some readers more than to others, according to their predilections, perhaps depending on whether the reader belongs (in the classification of scientists suggested long ago by Ostwald) to the group of "classicists" or to that of "romantics." It may be noted that, in the discussions of the genetic radiation hazards and of the genetic loads, rather limited attention is given to the fundamental problem of the differences between the mutational and the balanced (segregational) fractions, although it is stated that this matter belongs to the class of "uncertainties." The discussion of eugenics is admirably clear, concise, and as uncontroversial as any I have ever read.

It is almost an act of supererogation to say that this book can be highly recommended to those wishing to familiarize themselves with human genetics. It has no rivals. It will be widely read.

THEODOSIUS DOBZHANSKY
Department of Zoology,
Columbia University

Strategic Psychological Operations and American Foreign Policy. Robert T. Holt and Robert W. Van de Velde. University of Chicago Press, Chicago, Ill., 1960. x + 243 pp. $5.50.

This book is an attempt to state the principles of psychological strategy and to support these principles by reference, on the one hand, to social science research and, on the other hand, to three case studies of major international propaganda operations.

The strategic principles stated in the first three chapters are sensible, sound, and elementary. Readers new to problems of psychological strategy will learn something from them. So will some professionals, for many of these principles are not incorporated in current American practice. For example, the authors treat with proper disdain the notion that the purposes of this country's propaganda are to "sell America" or to create a more favorable image of the United States. They sensibly point out that the psychological instrument of statecraft is one of the major instruments used for achieving all the purposes of foreign policy, but that it is used along with the diplomatic, military, and economic instruments. If, however, professionals in the field of psychological strategy can learn from the introductory chapters, the fact that they can do so testifies to the sad state of the practice of the art (a point which Holt and Van de Velde emphasize), for by more sophisticated standards their summary of social research on persuasion would have to be considered a primer.

Chapter 4 is a rather lengthy blueprint of a table of organization for psychological strategy operations. Since the authors concede that a good program can operate under many different organizations, it is not clear what is gained by blueprinting one generally feasible and sensible organization among many.

The final three chapters, each concerned with a historic case of psychological operations, are intended to illustrate the principles outlined earlier, but the connections are sometimes unclear. The three cases are the American *Psywar* operations in Italy in 1943–45, American operations during the 1948 Italian elections, and Radio Free Europe during the thaw in the cold war. These histories may be useful, though they are not penetrating studies and they do tend to substitute assumption for evidence. This is not so much a criticism of the authors as of the general state of the documentation of public opinion. It is rare indeed, especially for historical cases, that one can find substantial evidence of what public opinion really was. Scholars are often forced, for lack of better evidence, to assume that the propaganda output corresponds to the public reactions. The systematic use of public opinion polls now permits a more faithful documenting of opinion phenomena. Thus, in the Holt–Van de Velde volume, some of the more interesting insights come where they use material from the DOXA polls in Italy.

ITHIEL DE SOLA POOL
Center for International Studies,
Massachusetts Institute of Technology

Outer Space Photography for the Amateur. Henry E. Paul. Amphoto, New York, 1960. 124 pp. Illus. $2.50.

Henry E. Paul, the author of this volume, knows his subject well and generously shares this knowledge with his readers. Celestial photography has been a hobby of his for over 20 years, and he has known personally most of the outstanding American amateurs in this field. Photographs comprise about 40 percent of the volume's contents, and many of them were made by amateurs.

After devoting the first three of the book's 12 chapters to general background and equipment, the author settles down to discuss the photography of star trails, rockets and satellites, the moon, the sun, eclipses, nebulae and galaxies (and comets and aurorae), and meteors and planets. He tells what kind of equipment is best for each and what type of film to use; he indicates the order of magnitude of the necessary exposure, and he warns the reader against some of the common mistakes.

The errors I found in this book are few and mostly unimportant; for example, on page 64, the suggestion that the exposure for photographing the moon at the first or last quarter should

be four times as long as that used for photographing a full moon. Actually nine would be a better factor for the first quarter and slightly more for the last quarter. However, if an amateur underexposes his first moon photograph, he can make corrections on his second try.

Paul suggests that one start by photographing star trails; as an illustration he uses an excellent photograph made by Paul W. Davis, of circumpolar trails. He might have mentioned that, by comparing such a photograph with one taken 50 years earlier, one can learn quite a bit about the precession of the equinoxes.

The book deserves a better binding and an index. It is an excellent book to recommend to amateurs seeking answers to questions about celestial photography.

CHARLES H. SMILEY
Ladd Observatory,
Brown University

Cultures and Societies of Africa. Simon Ottenberg and Phoebe Ottenberg, Eds. Random House, New York, 1960. x + 614 pp. Illus. $7.50.

Few editors have had the courage or the opportunity to present their intended readers, college and university teachers and students, with a selection such as this. The articles and excerpts reprinted here are largely by professional anthropologists, written mainly for fellow professionals. The volume is focused not on all the cultures and societies of Africa, but on those of Africa south of the Sahara; the primary stress is the traditional way of life in these areas. Anthropological "readers" are rarely organized within such strict limits. The editors and their publisher are to be congratulated for breaking new ground.

There are six sections: the 81-page general introduction by the editors; "People and environment" (five selections); "Social groupings" (seven selections); "Authority and government" (six selections); "Values, religion, and aesthetics" (eight selections); and "Culture contact and change" (six selections). There are, then, 32 articles and excerpts, by as many authors, included here. The majority deal with specific groups, and only four or five might be styled summary or survey articles. Most of the major areas of sub-Saharan Africa are represented, although unequally. For example, western Africa claims a major share, ten groups, compared with four groups for the central African Republic and two for the Congo area. Ethiopia and the Cape are not touched upon. In general, the representation is more even in terms of types of groups; these range from the Pygmies to the Ashanti.

The editors evince a strong predilection for materials published originally in English, and only two of their selections are translations. For each item an introduction and a section of annotated references "For further reading" are provided. The volume concludes with a 33-page classified bibliography, biographical notes on the contributors and editors, and an index. There are 26 pages of plates. An attractive end-paper map gives the approximate location of 28 tribes mentioned in the selections. In some cases, the location is *very* approximate (for example, the Tswana and the Swazi), and in one case (the Luapula) it is an area, not a tribe, that is designated.

The editors, and their cooperative publisher, have set high standards and have largely succeeded in maintaining them. Prospective users of the book should be warned, however, that there are a few traps.

Although the selections treat only sub-Saharan Africa, the editors, in the introduction, devote substantial space to the northern regions, space which might well have been devoted to a fuller treatment of the area actually covered by the volume. There are aspects of the introduction's organization which may lead to difficulties in the classroom: for example, among 13 subheads, one is called "Climate and cultures" and another "Means of livelihood." The rationale of this organization is unclear, and the reader must work back and forth to see where there are, or are not, cross-correlations among climate, culture, and means of livelihood. Most students will not willingly do this, and the task will inevitably fall to the teacher. Again, the authors create unnecessary work for teachers by subsuming kinship under "Social groupings"; and by saying, "The three basic kin relationships are those of descent, filiation, and marriage," only to dismiss filiation with a few brief sentences (page 28 and following). Regrettably, these and other lapses render the introduction somewhat less useful than it could have been.

A quarter of the selections are by American anthropologists; not all of these anthropologists were trained in this country, nor do they all write in the prevailing American tradition with its emphasis on culture. The remaining three-quarters are overwhelmingly by scholars who write in the British tradition of social anthropology. In fact, a majority of the more important British Africanists, with certain notable exceptions, are represented. This source of the selections means that, in most, there is a strong emphasis on problems, and even the more descriptive pieces often have a good deal of theory implicit in them. If a course happens to be organized on regional lines, or to be heavily factual in its orientation, the topical organization, in combination with the substantial theoretical content of the volume, may make this book a difficult one to use.

Many teachers and students will no doubt welcome the stimulating challenge of such a book. This challenge, met squarely, will prove richly rewarding.

ALFRED HARRIS
Department of Anthropology,
Brandeis University

High Energy Nuclear Physics. W. O. Lock. Methuen, London; Wiley, New York, 1960. xi + 190 pp. Illus. $3.25.

The latest volume in the Methuen monograph series on physical subjects is this pocketbook by Lock. I believe that these short books are the correct approach to providing excellent coverage of a limited subject which is part of a rapidly changing field. In contrast to some recent lengthy books on nuclear physics, to which a number of authors contributed incoherently on topics (and on the number of pages) assigned by an editor, this book, written by one person, provides a well-written, coordinated account of high-energy, pion, and nucleon physics, which is technically good and which is easy to understand.

The book is based on lectures given to first-year postgraduate students in nuclear physics at Birmingham University. Lock assumes that the reader will have an elementary knowledge of quantum mechanics and that he can supplement this knowledge by reference to the books and articles listed at the end of each chapter.

The text (188 pages) is subdivided into eight chapters: "Introduction"; "Properties of the pions"; "Fundamental concepts"; "The scattering of pions by protons"; "The photoproduc-

tion of pions from nucleons"; "Nucleon-nucleus scattering"; "Nucleon-nucleon elastic scattering"; and "Pion production in nucleon-nucleon collisions." No consideration is given to muons, strange particles, cosmic ray phenomena, electron scattering, or detailed theoretical models. The discussion of such specific topics as phase shift analysis, dispersion relation applications, and various phenomenological theories is adequate for graduate students, who will be able to understand their significance in the over-all concepts of meson and nucleon physics. Although some of the data are already a little out of date, this inexpensive book is, nevertheless, a detailed, well-rounded, and inviting account that deserves to be a part of every physicist's home library, whether he requires an introductory or a refresher course in high-energy nuclear physics.

H. W. KOCH

High Energy Radiation Section, National Bureau of Standards

Théorie Relativiste des Fluides à Spin. Francis Halbwachs. Gauthier-Villars, Paris, 1960. x + 294 pp.

This book gives an admirable account of researches on the properties and possible types of relativistic fluids possessing intrinsic angular momentum. The study of such fluids goes back to the early days of wave mechanics, when attempts were made to obtain a hydrodynamical interpretation of the then new quantum equations and, in particular, of the intrinsic spin of the electron. The recent revival of interest in the possibility of a causal interpretation of quantum phenomena has led to a deeper study of the hydrodynamical possibilities inherent in the theory of relativity.

After discussing the earlier relativistic hydrodynamical models proposed by Frenkel, Mathisson, and Weyssenhoff, the author turns to the recent advances made by Takabayasi and by Bohm and Vigier, and to the important developments due to Halbwachs himself.

Some people may feel inclined to liken these researches to the old attempts to construct gyroscopic models of the ether, but the work may not be dismissed so easily. The investigation of the full resources of relativistic hydrodynamics is of considerable interest in its own right, and contains many surprises; moreover, Bohm and Vigier, by relaxing a restriction imposed by Weyssenhoff, have already shown that two reasonable types of mass center exist which do not necessarily coincide, and that the resulting additional degrees of freedom give a possibility of new insight into the significance of the recent classification of elementary particles by means of strangeness and isotopic spin quantum numbers.

Though the book makes only passing reference to such quantized aspects of the work, it stresses the quantum motivation for the study of the often unexpected properties of these relativistic fluids. To those people who seek an authoritative, up-to-date, and unusually clear account of the whole field, the book is warmly recommended.

BANESH HOFFMANN

Department of Mathematics, Queens College, Flushing, New York

New Books

Biological Sciences

Asexual Propagation and Regeneration. M. A. Vorontosova and L. D. Liosner. Translated from the Russian by P. M. Allen. F. Billett, Ed. Pergamon, New York, 1960. 511 pp. Illus. $12.

Biology and Comparative Physiology of Birds. vol. 1. A. J. Marshall, Ed. Academic Press, New York, 1960. 530 pp. Illus. 100s.

Discussions on Child Development. A consideration of the biological, psychological, and cultural approaches to the understanding of human development and behavior. J. M. Tanner and Barbel Inhelder, Eds. International Universities Press, New York, 1960. 199 pp. $5. Proceedings of the fourth meeting of the World Health Organization study group on the psychobiological development of the child, Geneva 1956.

Elementary Biochemistry. Edwin T. Mertz. Burgess, Minneapolis, Minn., ed. 2, 1960. 300 pp. Illus. $6.50.

Encyclopedia of Plant Physiology. vol. 5, pts. 1 and 2, *The Assimilation of Carbon Dioxide.* W. Ruhland, Ed. Springer, Berlin, 1960. 1053 pp.; 894 pp. Illus. DM. 530.

Handbook of Physiology. A critical, comprehensive presentation of physiological knowledge and concepts. Section 1, *Neurophysiology*, vol. 3, John Field, Editor-in-Chief. H. W. Magoun, Section Ed. American Physiological Soc., Washington, D.C., 1960 (order from Williams and Wilkins, Baltimore, Md.). 578 pp. Illus. $20.

The Metabolic Basis of Inherited Disease. John B. Stanbury, James B. Wyngaarden, and Donald S. Fredrickson, Eds. McGraw-Hill, New York, 1960. 1490 pp. Illus. $30. This book is intended to give a critical and comprehensive account of those heritable disorders of metabolism for which an appreciable body of knowledge exists; "the editors enlisted the collaboration of investigators [47] actively engaged in the . . . study of specific heritable diseases."

Phenolics in Plants in Health and Disease. Proceedings of a plant phenolics group symposium held at Bristol, April 1959. J. B. Pridham, Ed. Pergamon, New York, 1960. 141 pp. $7.50.

The Problem of Acute Hypothermia. P. M. Starkov. Translated from the Russian by R. E. Hammond. E. Neil, Ed. Pergamon, New York, 1960. 327 pp. $12.

Radioactive Isotopes in Biochemistry. Engelbert Broda. Elsevier, Amsterdam; Van Nostrand, Princeton, N.J., 1960. 386 pp. Illus. $11.50.

Reproduction in the Dog. A. E. Harrop. Williams and Wilkins, Baltimore, Md., 1960. 215 pp. $7.

Steric Aspects of the Chemistry and Biochemistry of Natural Products. J. K. Grant and W. Klyne. Cambridge Univ. Press, New York, 1960. 144 pp. Illus. $5.50. Biochemical Society Symposia No. 19.

Structure and Function of the Cerebral Cortex. D. B. Tower and J. P. Schade, Eds. Elsevier, Amsterdam; Van Nostrand, Princeton, N.J., 1960. 460 pp. Illus. $17. Proceedings of the Second International Meeting of Neurobiologists, Amsterdam, 1959.

Toxicology. Mechanisms and analytical methods. vol. 1. C. P. Stewart and A. Stolman, Eds. Academic Press, New York, 1960. 791 pp. Illus. $22.

Treatise on Invertebrate Paleontology. pt. 1, *Mollusca 1.* Raymond C. Moore, Ed. Geological Soc. of America and Univ. of Kansas Press, Lawrence, 1960. 1374 pp. $7.50.

Unity and Diversity in Biochemistry. An introduction to chemical biology. Marcel Florkin. Translated by T. Wood. Pergamon, New York, 1960. 410 pp. Illus. $10.

Economics and the Social Sciences

Administration of Teaching in Social Sciences in the U.S.S.R. Syllabi for three required courses. Univ. of Michigan, Ann Arbor, 1960. 146 pp. The courses covered —dialectical and historical materialism, political economy, and history of the C.P.S.U.—are required of every Soviet college-level student, whatever his program of study.

The American Supreme Court. Robert G. McCloskey. Univ. of Chicago Press, Chicago, Ill., 1960. 272 pp. $5.

Behaviour Therapy and the Neuroses. Readings in modern methods of treatment derived from learning theory. H. J. Eysenck, Ed. Permamon, New York, 1960. 490 pp. Illus. $10.

Delinquency and Opportunity. A theory of delinquent gangs. Richard A. Cloward and Lloyd E. Ohlin. Free Press, Glencoe, Ill., 1960. 231 pp. $4.

Doctoral Research on Russia and the Soviet Union. Jesse J. Dossick. New York Univ. Press, New York, 1960. 248 pp. $6. The examination of 150,000 titles culled from several scores of sources resulted in a master list of 960 American, British, and Canadian doctoral dissertations on Russia and the Soviet Union. They are classified into sections, such as agriculture, anthro-

pology, art, communications, and education. Each dissertation is listed alphabetically with name of author, title, university, and date of acceptance.

The Emerging States of French Equatorial Africa. Virginia Thompson and Richard Adloff. Stanford Univ. Press, Stanford, Calif., 1960. 607 pp. $8.75.

The Export Economies. Their pattern of development in historical perspective. Jonathan V. Levin. Harvard Univ. Press, Cambridge, Mass., 1960. 362 pp. Illus. $6.75.

Handbook of Research Methods in Child Development. Paul H. Mussen, Ed. Wiley, New York, 1960. 1071 pp. $15.25.

The History of Modern Culture. Maurice Parmelee. Philosophical Library, New York, 1960. 1305 pp. $10.

Husbands and Wives. The dynamics of married living. Robert O. Blood, Jr., and Donald M. Wolfe. Free Press, Glencoe, Ill., 1960. 305 pp. $5.

The New Science of Management Decision. Herbert A. Simon. Harper, New York, 1960. 62 pp. $2.50. Lectures delivered at New York University (1960) in which Simon discusses the types of business problems that can be handled successfully at the present time by automated processes and describes some current scientific investigations into the possibilities of automating nonrepetitive types of decisions.

Psychological Techniques in Diagnosis and Evaluation. Theodore C. Kahn and Martin B. Giffen, Pergamon, New York, 1960. 175 pp. $6.50.

Reading and the Psychology of Perception. Hunter Diack. Philosophical Library, New York, 1960. 178 pp. $6.

Records of the American-Australian Scientific Expedition to Arnhem Land. vol. 2, *Anthropology and Nutrition*. Charles P. Mountford, Ed. Melbourne Univ. Press, Melbourne, Australia; Cambridge Univ. Press, New York, 1960. 528 pp. Illus. $19.50.

Sources of Information on Behavioral Problems of Adolescence. An index of scientific studies and their sources dealing with youth from ages 14 to 22. Compiled by the Committee on Academic Education. American Psychiatric Assoc., Washington 9, 1960. 96 pp. Paper, $3.

The Structural Basis of Behavior. J. A. Deutsch. Univ. of Chicago Press, Chicago, Ill., 1960. 195 pp. $3.50.

The Transformation of Russian Society. Aspects of social change since 1861. Cyril E. Black, Ed. Harvard Univ. Press, Cambridge, Mass., 1960. 702 pp. $9.75.

Trends in the American Economy in the Nineteenth Century. Princeton Univ. Press, Princeton, N.J., 1960. 791 pp. $15.

General

About Chemistry. Magnus Pyke. Macmillan, New York, 1960. 218 pp. Illus. $4.50.

Air Pollution Manual. pt. 1, *Evaluation*. American Industrial Hygiene Assoc., Detroit, Mich., 1960. 194 pp.

The Amateur Scientist. C. L. Strong. Simon and Schuster, New York, 1960. 606 pp. Illus. $5.95. Contains projects presented in Strong's monthly column in the *Scientific American*.

American Forestry. Six decades of growth. Henry Clepper and Arthur B. Meyer, Eds. Society of American Foresters, Washington, D.C., 1960. 331 pp. $5. The volume, published in commemoration of the 60th anniversary of the American Foresters Society, is intended to be a factual account of the development of forestry in all its branches during the past 60 years.

The Autobiography of Science. Forest Ray Moulton and Justus J. Schifferes, Eds. Revised and enlarged by Justus J. Schifferes. Doubleday, Garden City, N.Y., ed. 2, 1960. 781 pp. $5.95. An anthology containing more than 100 selections from scientists' own explanations of their work: Newton, Harvey, Franklin, Madame Curie, and others.

The Breaking of the Circle. Studies in the effect of the "New Science" upon 17th-century poetry. Marjorie Hope Nicholson. Columbia Univ. Press, New York, ed. 2, 1960. 227 pp. Illus. $3.75.

Careers and Opportunities in Science. A survey of all fields. Philip Pollack. Dutton, New York, rev. ed., 1960. 200 pp. + plates. $3.95.

The Commonsense Book of Drinking. Leon D. Adams. McKay, New York, 1960. 224 pp. $3.95.

Flight Facts for Private Pilots. Merrill E. Tower. Aero, Los Angeles, Calif., 1960. 212 pp. Illus. $5.

The Foundations of Science. Sheldon J. Lachman. Vantage Press, New York, 1960. 121 pp. $2.95.

Glenn's New Auto Repair Manual. With 1950–1960 specifications. Harold T. Glenn. Chilton, Philadelphia, Pa., 1960. 955 pp. Illus. $7.95.

Goldfish Varieties and Water Gardens. William T. Innes. Innes, Philadelphia, Pa., 1960. 385 pp. Illus. $6.95.

The Human Use of the Earth. Philip L. Wagner. Free Press, Glencoe, Ill., 1960. 285 pp. Illus. $6.

Imperfect Picture. An appreciation of the scientific and philosophic thought of Alfred Claude Jessup. Edward F. Emley. Heffer, Cambridge, England, 1960. 202 pp. 15s.

Information Please Almanac. Atlas and yearbook, 1961. McGraw-Hill, New York, 1960. 895 pp. Illus. Paper, $1.35.

The Living Laboratory. James D. Witherspoon and Rebecca H. Witherspoon. Doubleday, Garden City, N.Y., 1960. 256 pp. Illus. $3.95. Witherspoon, director of a graduate school laboratory at Purdue University, and his wife, a member of the entomology department at Purdue, have assembled 200 experiments for amateur biologists.

Men of Space. Profiles of the leaders in space research, development, and exploration. vol. 1. Shirley Thomas. Chilton, Philadelphia, Pa., 1960. 255 pp. Illus. $3.95. Profiles of Ehricke, Goddard, Schriever, Stapp, Tsiolkovsky, Van Allen, von Braun, von Kármán, von Neumann, and Yeager.

101 Simple Experiments with Insects. H. Kalmus. Doubleday, Garden City, N.Y., 1960. 194 pp. Illus. $2.95. Kalmus is on the staff of Galton Laboratory, University of London.

The Orphic Voice. Poetry and natural history. Elizabeth Sewell. Yale Univ. Press, New Haven, Conn., 1960. 473 pp. $7.50.

People. Challenge to survival. William Vogt. Sloane, New York, 1960. 272 pp. $4.50.

Protestant Thought and Natural Science. A historical interpretation. John Dillenberger. Doubleday, Garden City, N.Y., 1960. 310 pp. $4.50.

Russian Science in the 21st Century. Sergei Gouschev and Mikhail Vassiliev. McGraw-Hill, New York, 1960. 222 pp. $4.95. The authors, Russian science writers, interviewed outstanding figures in every field of Russia today, asking them to point out the trends and logical results of projects now in preliminary stages.

Russian for Scientists. A grammar and reader. C. R. Buxton and H. Sheldon Jackson. Interscience, New York, 1960. 318 pp. $5.25.

Science Book List for Children. Hilary J. Deason, Ed. AAAS, Washington, D.C., 1960. 151 pp. $1. The list is intended as a guide to recreational and collateral reading in science (including mathematics) for elementary school students up to and including the eighth grade. Ruth N. Foy served as a consultant.

Science Ponders Religion. Harlow Shapley, Ed. Appleton-Century-Crofts, New York, 1960. 318 pp. $5.

Scientists Who Changed the World. Lynn and Gray Poole. Dodd, Mead, New York, 1960. 177 pp. $3.

Self-Developing America. Harold J. Ruttenberg. Harper, New York, 1960. 267 pp. $4.50.

The Southern Regional Education Board: Ten Years of Regional Cooperation in Higher Education. Redding S. Sugg, Jr., and George Hilton Jones. Louisiana State Univ., Baton Rouge, 1960. 194 pp. $4.

Soviet Education Programs. Foundations, curriculums, teacher preparation. William K. Medlin, Clarence B. Lindquist, and Marshall L. Schmitt. U.S. Office of Education, Washington, D.C. (order from Supt. of Documents, GPO, Washington 25). 281 pp. $1.25.

A Structure of Science. Joseph H. Simons. Philosophical Library, New York, 1960. 281 pp. $4.75.

That All May Learn to Read. Papers presented at the the First Annual Reading Conference, Reading Center, School of Education, University Division of the Summer Session, Syracuse University, 1959. Roy A. Kress, Ed. Reading Center, Syracuse Univ., Syracuse, N.Y., 1960. 94 pp.

Mathematics, Physical Sciences, and Engineering

Inertial Guidance. Charles S. Draper, Walter Wrigley, and John Hovorka. Pergamon, New York, 1960. 136 pp. Illus. $6.50.

Infrared Methods. Principles and applications. G. K. T. Conn and D. G. Avery. Academic Press, New York, 1960. 211 pp. Illus. $6.80.

Mathematical Tables for the Approximation of Geophysical Anomalies and Reductions by Interpolation Polynomials. V. A. Kazinskii. Translated by D. E. Brown. Pergamon, New York, 1960. 98 pp. $5.50.

Reports

Role of Enzyme Induction in Embryonic Development

Abstract. Measurement of tryptophan pyrrolase activity in embryos of *Rana pipiens* did not reveal significant amounts of constitutive enzyme. All attempts to induce enzyme formation in embryos by culture in tryptophan solution or in ovarian eggs by injection of tryptophan into the mature female were negative.

In 1958 Stearns and Kostellow (*1*) reported on tryptophan pyrrolase activity in dissociated embryonic cells of *Rana pipiens*. Enzyme activity was not detected in the intact embryo before hatching. In embryos dissociated into cell cultures at a stage prior to gastrulation and incubated in L-tryptophan, enzyme activity could be detected, reaching a maximum level between 8 and 10 hours of incubation. Of striking import was the observation that, before the onset of gastrulation, populations of presumptive endoderm cells demonstrated enzyme activity after tryptophan incubation. After gastrulation was complete, enzyme activity could be induced only in those cultures containing presumptive gut cells. From this work it may be concluded that tryptophan pyrrolase activity can be induced in cells lacking constitutive enzyme. These results have been frequently cited in support of the hypothesis that enzyme induction plays an important role in embryonic development.

In contrast to this observation is the report by Nemeth and Nachmias (*2*) and that by Auerbach and Waisman (*3*) that tryptophan pyrrolase is present in adult mammalian liver but is either absent or at very low levels in fetal liver. Nemeth (*4*) demonstrated that tryptophan pyrrolase activity rises to adult levels 24 hours after birth in the guinea pig and rabbit and 15 days after birth in the rat. Injections of tryptophan did not increase tryptophan pyrrolase activity in fetal liver, and the response to injection in all species developed simultaneously with the rapid increase of enzyme activity to adult levels.

In view of the conflicting results between the mammalian and the amphibian data we decided to repeat the work of Stearns and Kostellow using Friedberg and Eakin's method (*5*) of cutting embryos into halves and quarters to permit penetration of substrate. Accordingly, the jelly and vitelline membrane were removed from *Rana pipiens* eggs by the papain-thioglycolate method of Spiegel (*6*). Intact embryos, halves, and quarters were incubated for 12 hours in either Holtfreter's solution or 0.02*M* L-tryptophan in Holtfreter's solution. Cut embryos remained alive, as indicated by normal closure of the cut surface in both control and tryptophan media. After five washings with Holtfreter's solution, tryptophan pyrrolase activity was measured in 12.5-percent homogenates by the method of Knox and Auerbach (*7*). The results of seven experiments with 4200 embryos per experiment indicated no constitutive enzyme present in either the blastula, late gastrula, or early neurula stages. Of importance is the result that incubation in L-tryptophan failed to induce enzyme activity in these stages.

Stage 25 (*8*) embryos were cultured in either 10-percent Holtfreter's solution or 0.03*M* L-tryptophan (in 10-percent Holtfreter's solution) for either 6 or 24 hours. Measurement of tryptophan pyrrolase activity again revealed no constitutive enzyme, and no indication of activity was noted after tryptophan treatment.

Enzyme measurements were also made on ripe ovaries of adults, and no constitutive enzyme was detected. Attempts were made to induce enzyme formation by injecting mature females with 15 mg of L-tryptophan in 3.0 ml of 0.65-percent sodium chloride and by assaying ovarian homogenates 3, 6, and 9 hours after injection. No enzyme activity was detected. During this period, however, a 420-percent increase was noted in liver tryptophan pyrrolase activity (40.5 ± 4.90 versus a basal activity of 9.64 ± 1.26) (*9*). These results are in agreement with the results of Nemeth (*4*) on fetal and adult mammals. Tryptophan pyrrolase activity is absent during early stages of development and cannot be induced in the absence of significant amounts of constitutive enzyme.

The methods employed by Stearns and Kostellow may have increased the permeability of embryonic cells to the substrate, which may account for our failure to confirm their observations. A detailed report of their methods would permit the testing of this hypothesis. The work reported here, however, does not support the hypothesis that substrate induction of enzymes plays an important role in development (*10*).

MELVIN SPIEGEL
DAVID L. FRANKEL
Department of Zoology, Dartmouth College, Hanover, New Hampshire

References and Notes

1. R. L. Stearns and A. B. Kostellow, in *A Symposium on the Chemical Basis of Development*, W. D. McElroy and B. Glass, Eds. (Johns Hopkins Press, Baltimore, 1958).
2. A. M. Nemeth and V. T. Nachmias, *Science* **128**, 1085 (1958).
3. V. H. Auerbach and H. A. Waisman, *J. Biol. Chem.* **234**, 304 (1959).
4. A. M. Nemeth, *ibid.* **234**, 2921 (1959).
5. F. Friedberg and R. M. Eakin, *J. Exptl. Zool.* **110**, 33 (1949).
6. M. Spiegel, *Anat. Record* **111**, 544 (1951).
7. W. E. Knox and V. H. Auerbach, *J. Biol. Chem.* **214**, 307 (1955).
8. W. Shumway, *Anat. Record* **78**, 139 (1940).
9. Activity is expressed in micromoles of kynurenine per gram (dry weight) per hour, plus or minus standard error of the mean.
10. This work was supported in part by U.S. Public Health Service research grant No. E-3030.

23 September 1960

Instructions for preparing reports. Begin the report with an abstract of from 45 to 55 words. The abstract should *not* repeat phrases employed in the title. It should work with the title to give the reader a summary of the results presented in the report proper.

Type manuscripts double-spaced and submit one ribbon copy and one carbon copy.

Limit the report proper to the equivalent of 1200 words. This space includes that occupied by illustrative material as well as by the references and notes.

Limit illustrative material to *one* 2-column figure (that is, a figure whose width equals two columns of text) or to *one* 2-column table or to *two* 1-column illustrations, which may consist of two figures or two tables or one of each.

For further details see "Suggestions to Contributors" [*Science* **125**, 16 (1957)].

Differential Thermograms of Polysaccharides

Abstract. Carrageenans and various other polysaccharides were characterized by differential thermal analysis in an atmosphere of air. The carrageenans, although isolated from different sources, had essentially the same thermographic characteristics. Of the other compounds studied, such closely related polysaccharides as amylose and amylopectin showed widely different thermal behavior. Thermographic replication was highly satisfactory.

The characterization of clay minerals by differential thermal analysis is a technique widely used in the past (*1*). Very little work, however, has been concerned with the use of this technique in the characterization of organic compounds. A survey of the possibility of using differential thermal analysis to characterize simple organic compounds —that is, organic acids and their derivatives—has been reported (*2*, *3*). In an

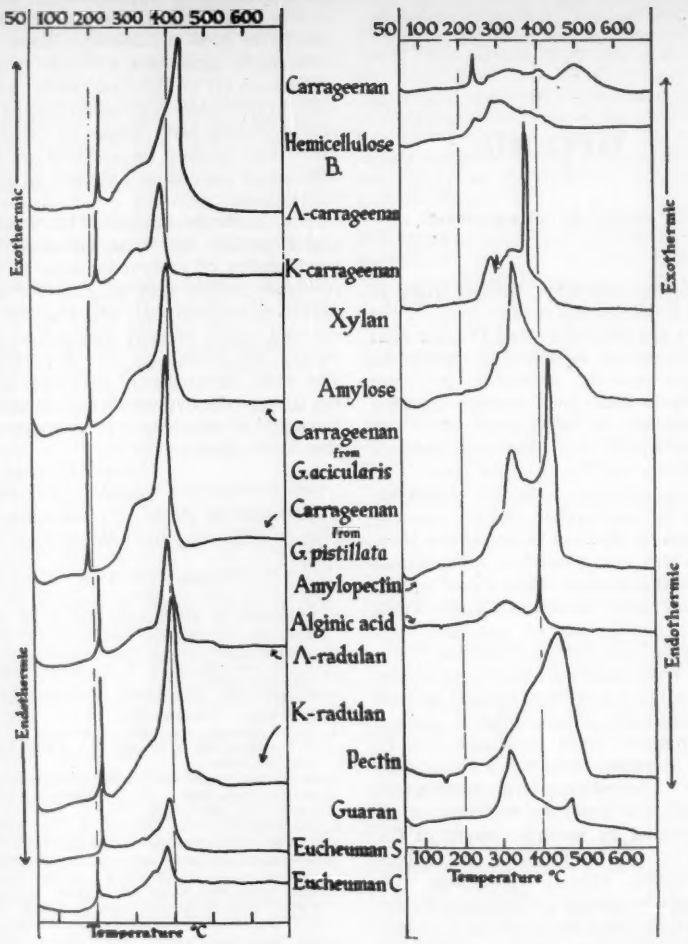


Fig. 1. Differential thermograms of polysaccharides determined in an atmosphere of air.

attempt to relate the thermograms of dextrans with their physical and chemical properties, Morita (*4*) concluded that supplementation of the differential thermal analysis data with viscosity and molecular weight determinations yielded valuable information concerning the constitution of these compounds. Endotherms in the 100° to 310°C region were related to the type of linkage encountered in these dextrans. Further variations were associated with solubility changes and unique viscosity properties.

The apparatus used in our experiments consisted of a furnace in which the rate of increase in temperature was adjusted to 10°C per minute. The temperature differential between the sample (polysaccharide) and a thermally inert standard (calcined alumina) was measured by a two-headed platinum-iridium differential thermocouple. The furnace temperature was measured by a platinum–platinum-10-percent rhodium thermocouple. The polysaccharide (*5*) was thoroughly mixed with three times its weight of calcined alumina prior to packing in the nickel sample holder. There was free access of air during all determinations. The data were automatically recorded on a Leeds and Northrup Speedomax type G recorder and plotted with furnace temperature as abscissa and differential temperature as ordinate.

The carrageenan thermograms shown in Fig. 1 (at left) have essentially the same shapes irrespective of their method of preparation. They each possess a sharp exotherm in the 200°C region and a large, broad exotherm starting at approximately 250°C and reaching a maximum in the 400°C region. The carrageenans are sulfated polysaccharides composed almost entirely of D-galactose residues and found in the cell wall of red marine algae. The exotherm at 200°C is not displayed by any of the nonsulfated polysaccharides. On the other hand, the thermogram (not shown) of agar, another sulfated polysaccharide, has a similar sharp exothermic peak at 265°C. It is therefore assumed that these peaks are a function of these sulfated esters. The thermograms of the carrageenan and of the hemicellulose B (Fig. 1, at right) suggest that these preparations are mixtures of compounds.

Amylose and amylopectin show essentially the same differential thermal curve up to a temperature of 380°C, with both possessing an exothermic reaction maximum at 330°C. At temperatures above 330°C, the branched amylopectin molecule shows a second, large exothermic reaction at 425°C. The exothermic reaction of the straight-chained amylose molecule above 330°C does not display such a large energy change on reaction. However, the temperatures at which thermal reactions cease are 570° and 470°C, respectively; for amylose and amylopectin, showing that amylose has a higher thermal stability when the two polysaccharides are heated in air.

The two uronic acid-containing polysaccharides—namely, alginic acid and pectin—display a small endothermic reaction at 145° and 155°C, respectively. These reactions are believed to be due to decarboxylation of the uronic carboxyl group. This is inferred from a similar reaction occurring with 3-indoleacetic acid to form skatole at 170°C (*3*).

At this time, little can be postulated concerning the thermal reactions of the xylan or the guaran. Duplication of the thermograms was highly satisfactory in all cases. Although the mechanism of these thermal reactions of polysaccharides cannot be completely elucidated, it is suggested that this technique may have application in the field of polysaccharide characterization and in general identification of organic compounds (*6*).

G. CHESTERS
S. O. THOMPSON
Department of Soils, University of Wisconsin, Madison

References and Notes

1. R. C. Mackenzie, Ed., *Differential Thermal Investigation of Clays* (Mineralogical Society, London, 1957).
2. F. Mattu and R. Parisi, *Rend. seminar. fac. sci. univ. Cagliari* **22**, 81, 170, 177 (1952); *ibid.* **25**, 96 (1955); *Chimica (Milan)* **8**, 188 (1953).
3. G. Chesters, O. N. Allen, O. J. Attoe, *Soil Sci. Soc. Am. Proc.* **23**, 454 (1959).
4. H. Morita, *Anal. Chem.* **28**, 64 (1956); *J. Am. Chem. Soc.* **78**, 1397 (1956).
5. We are indebted to Prof. R. L. Whistler of Purdue University and to Dr. L. Stoloff of Marine Colloids, Inc., Rockland, Me., for providing the polysaccharide samples used in this study.
6. This work was supported in part by a grant from the graduate school of the University of Wisconsin, Madison; the report is published with the approval of the director, Wisconsin Agricultural Experiment Station, Madison.

12 October 1960

Ticks from European-Asiatic Birds Migrating through Egypt into Africa

Abstract. From 321 of 7381 birds (28 species), 504 immature European-Asiatic ticks were collected: *Ixodes frontalis, Haemaphysalis punctata, Haemaphysalis sulcata, Hyalomma* spp. (probably mostly *m. marginatum*), *Hyalomma aegyptium,* and *Hyalomma m. marginatum.* Many additional detaching ticks were eaten by the hosts. Uninfested bird species numbered 29 (998 individuals).

Permanently established populations or isolated specimens of several tick species which, in their immature stages, infest birds in Asia, Europe, and Africa have been found far from their normal geographic range, almost certainly carried there by migrating birds. Examples are the European-Asiatic *Hyalomma m. marginatum* recovered in Kenya and Sudan (*1*) and in Egypt (*2*) and the following tropical and South African species: *H. marginatum rufipes* and *H. impressum,* found in the U.S.S.R. (*1–3*); *Amblyomma variegatum,* in France (*1*); *A. hebraeum,* in Bulgaria (*1*); and *A. lepidum,* in Palestine (*4*) and in Azerbaijan (*5*).

Because of the unusual ability of ticks to transmit many varied pathogens or to harbor them for long periods, and because of the association of birds with numerous viruses and rickettsia affecting man, an effort was made between September and December of 1959 to determine the incidence and the kind of tick infestation among European-Asiatic birds migrating southward through Egypt into Africa (*6*). African ticks from birds migrating through Egypt northward to Asia and Europe have previously been reported (*2*).

Most of the birds were trapped or netted in Egyptian coastal areas between Port Said and Mersa Matruh; a few were shot near Cairo. The birds were immediately examined for ticks; uninfested ones were released. The hosts were kept alive until the ticks completed engorgement and detached. Wherever possible, immature ticks were reared to adulthood to insure correct species determination.

Of 8379 migrants examined, 7381 belonged to 28 tick-infested species (Table 1) and 998, to 29 noninfested species; 504 ticks were recovered from 321 birds. In early stages of the work, facilities to prevent the hosts from eating the detaching parasites were inadequate, and numerous ticks—probably more than the number recovered—were lost.

The 504 ticks collected were 88 *Ixodes frontalis* (17.46 percent), 84 *Haemaphysalis punctata* (16.68 percent), 2 *H. sulcata* (0.39 percent), 243 *Hyalomma* sp. (probably mostly *m. marginatum*) (48.21 percent), 11 *H. aegyptium* (2.18 percent), and 76 *H. m. marginatum* (15.08 percent).

Both the number of migrants and the rate of infestation were greatest in September. During that month, 5721 birds were examined, of which 296 (5.16 percent) were infested. In October, with an equal amount of effort, 1480 birds were collected; of these only 19 (1.28 percent) were infested. Migrants taken in November and December may have been present in Egypt for some weeks. In November, five of 174 specimens examined were infested; in December, six were examined and one bore ticks.

Egypt receives bird migrants from the north and northeast (probably more from the latter than from the former direction); this area extends from eastern Europe and the U.S.S.R. to the region east of the Caspian basin and to the coasts of Syria and Palestine (*7*). Almost 300 species enter Egypt. The 57 species taken during this study represent those most easily netted and trapped in autumn on the northern coast.

Quails, *Coturnix c. coturnix,* and willow warblers, *Phylloscopus t. trochilus,* both taken in large numbers, carried each of the tick species collected except *Haemaphysalis sulcata.* These birds, which ate many ticks that detached, were therefore much more heavily infested than recovery figures in Table 1 indicate. Host species from which ten or more ticks were recovered were *Emberiza caesia, Anthus t. trivialis, Phylloscopus t. trochilus, P. t. acredula, Sylvia c. communis, Monticola saxatilis, Oenanthe o. oenanthe, Saxicola r. rubetra, Phoenicurus p. phoenicurus, Luscinia luscinia,* and *Coturnix c. coturnix.*

Twenty-nine noninfested species of birds, represented by 998 specimens, were *Carduelis spinus* (62), *Serinus canaria serinus* (15), *Acanthus cannabina mediterranea* (16), *Emberiza c.*

Table 1. Tick-infested fall migrants, 1959.

Host species	No. examined	No. infested	Ticks (No.)						
			Ixodes frontalis	*Haemaphysalis*		*Hyalomma*			Total
				punctata	*sulcata*	*sp.*	*aegyptium*	*m. marginatum*	
Sturnus vulgaris purpurascens	6	1				1			1
Oriolus o. oriolus	102	3				2		1	3
Carduelis carduelis niediecki	11	1				1			1
Chloris chloris chlorotica	35	1				1			1
*Emberiza caesia**	3	3				28	1		29
*Emberiza hortulana**	2	2				3			3
*Anthus c. campestris**	3	3				9			9
Anthus t. trivialis	30	5		12		5	1	13	31
Motacilla flava subsp.	1	1			1				1
Lanius cristatus collurio	411	7	2			2		4	8
Muscicapa s. striata	99	8	2	1		6			9
Phylloscopus t. trochilus†	1126	95	33	2		109			144
Phylloscopus trochilus acredula	1	1	1			9			10
Phylloscopus c. collybita	1	1	1			1			2
Sylvia c. communis	227	3	14			1			15
Monticola saxatilis	2	1						10	10
Oenanthe sp.	55	2		1		2			3
Oenanthe isabellina	50	2				3			3
Oenanthe o. oenanthe	112	4		1	1	10			12
Saxicola r. rubetra	217	9	1	3		12			16
Phoenicurus p. phoenicurus	322	27	12			22		13	47
Luscinia luscinia‡	62	9	19	1				2	22
Luscinia m. megarhyncha‡		3	1	1				1	3
Merops apiaster	4	1						1	1
Coracias g. garrulus	36	1						1	1
Jynx t. torquilla	12	1				3			3
Cuculus c. canorus	20	1				1			1
Coturnix c. coturnix†	4431	125	2	62		12	9	30	115
Total	7381	321	88	84	2	243	11	76	504

* Each bird was trapped on a different day, suggesting different family groups. † These birds ate many detaching ticks. ‡ *Luscinia* spp. infested with ticks were identified as to species; those not infested were either *L. luscinia* or *L. m. megarhyncha.*

calandra (47), *Motacilla a. alba* (34), *Lanius minor* (96), *Phylloscopus* sp. (63), *Acrocephalus* sp. (39), *Hirundo r. rustica* (26), *Upupa e. epops* (39), *Alcedo a. atthis* (11), *Streptopelia t. turtur* (501), *Cursorius c. cursor* (16), and 16 other species (totaling 33 specimens), represented by one to five specimens each.

The human diseases with which *Hyalomma m. marginatum* and *Haemaphysalis punctata* have been epidemiologically or experimentally associated in the areas from which the ticks in question originate are Crimean hemorrhagic fever, Q fever, tularemia, tick typhus, and brucellosis. These species are also vectors of several pathogens causing diseases in domestic animals.

HARRY HOOGSTRAAL
MAKRAM N. KAISER
Department of Medical Zoology, U.S. Naval Medical Research Unit No. 3, American Embassy, Cairo, Egypt

References and Notes

1. H. Hoogstraal, "African Ixodoidea, I. Ticks of the Sudan" (U.S. Navy, Washington, D.C., 1956).
2. ——— and M. N. Kaiser, *Ann. Entomol. Soc. Am.* **51**, 12 (1958).
3. V. N. Ter-Vartanov *et al.*, *Zool. Zhur.* **35**, 173 (1956).
4. F. S. Bodenheimer, *Mem. Inst. Egypt* **33**, 1 (1937); B. Feldman-Muhsam, *Bull. Research Council Israel* **B5**, 193 (1955).
5. M. V. Pospolova-Shtrom and N. S. Abusalimov, *Med. Parazitol. Parazitar. Bolezni* **26**, 56 (1957).
6. We are grateful to Sobhy Gaber and Ezzat Guindy of this department for excellent technical assistance and to Melvin Traylor, Jr., of the Chicago Natural History Museum for help in identifying the birds.
7. R. Meinertzhagen, *Nicoll's Birds of Egypt* (Rees, London, 1930).

23 September 1960

Electrophoretic Analysis of Young Alligator Serum

Abstract. Serum from 30 young alligators was examined by free boundary, starch block, and cellulose acetate strip electrophoresis. The patterns obtained showed that the alligator serum proteins differ significantly from those of other chordates in that an α-globulin is the major component. The average ratio of α-globulin to albumin in the serum is 3.4. In this respect it resembles serum of human beings with renal disease in which the α-globulin ratio to albumin ratio reaches 3.0.

Upon making an electrophoretic analysis of alligator serum for another study, we noted that the pattern (Fig. 1) was significantly different from other chordate patterns (*1*) in that the major component is not albumin but an α-globulin. Since then, we have examined the sera from over 30 individual animals, and in all cases, we have obtained patterns similar to the one shown.

Table 1. Mobility and percentage composition of alligator serum proteins as measured from ascending patterns of free-boundary electrophoresis. Mobilities are average of nine measurements showing mean deviation. Percentage composition of six individual alligators, measured by a planimeter, is given.

Component	Mobility (10^{-5} cm^2/v sec)	Relative composition (%)
Albumin	7.69 ± 0.34	13.88 ± 2.74
α_1-Globulin	5.54 ± 0.28	32.59 ± 3.19
α_2-Globulin	4.41 ± 0.24	15.27 ± 3.60
β_1-Globulin	3.58 ± 0.28	21.88 ± 3.71
β_2-Globulin	2.10 ± 0.14	11.40 ± 3.55
γ-Globulin	0.51 ± 0.11	4.93 ± 1.55

The average ratio of α-globulin to albumin in alligator serum is 3.4. In this respect it resembles serum of human beings with renal disease in which the ratio of α-globulin to albumin reaches 3.0 (*2*).

The presence of such large globulin-to-albumin ratios can be misleading in electrophoretic analysis, since it is possible to conclude, on the basis of mobilities, that a component is present in the serum which migrates ahead of the albumin, such as is observed in synovial fluid (*3*). Therefore, the following experimental results are presented in support of our conclusion that the major (33 percent) component of alligator serum behaves as an α-globulin.

The serum was obtained from young alligators (*Alligator mississipiensis*), approximately 60 cm long, by cardiac puncture. Both fresh and stored frozen sera were used in this study, and no significant differences in electrophoretic behavior were observed between them. Serum was examined by moving-boundary electrophoresis in the Perkin-Elmer model 38 apparatus, by starch block electrophoresis, and by the cellulose acetate strip method of Kohn (*4*). Prior to analysis, serum was dialyzed against several changes of sodium diethylbarbiturate buffer, *p*H 8.6, with constant stirring for 48 hours at 4°C. The ionic strength of the buffer for the moving boundary and starch electrophoresis was 0.1; that for the acetate strip method, 0.05.

The ascending patterns from the moving-boundary analysis were used for all mobility and percentage composition measurements because the ascending pattern gave better resolution between the components. A typical pattern is shown in Fig. 1; Table 1 gives the mobilities and the percentage composition of the various components. For purposes of identification the peaks were arbitrarily labeled in order of decreasing mobility as albumin, α_1, α_2, β_1, β_2, and γ-globulin. In order to study the sedimentation behavior of the leading components, fractionation was carried out by zone electrophoresis with potato starch, washed three times in distilled water and once in buffer, as the medium. One-centimeter sections were extracted with 6 ml of 1 percent sodium chloride and examined in the Spinco model E analytical ultracentrifuge at 56,100 rev/min at 25°C. The albumin fraction had one component with an $S_{20,w}$ value of 4.1 *S*. The α-globulin fraction contained a major component (90 percent) with an $S_{20,w}$ value of 16.6 *S* and a minor component, $S_{20,w}$ of 3.4 *S*. These sedimentation coefficients are similar to those reported for other serum albumins and α-globulins (*5*). The 16.6 *S* component of the α-globulin fraction could account for most of a major sedimentation component of alligator serum (13.9 *S* in serum).

The alligator albumin and α-globulin fractions also were added to rabbit serum and examined by the cellulose acetate method of Kohn (*4*), by which a relatively large separation between the albumin and globulins is obtained. It was found that alligator albumin migrated with the rabbit albumin, and the alligator α-globulin with the rabbit globulin. Further experiments were carried out with the moving-boundary apparatus in which it was found that bovine serum albumin (Armours No. 2266), when added to alligator serum, moved with the alligator albumin. Hyaluronic acid (Nutritional Biochemicals) also was added to alligator serum, because the mucin clot obtained under certain conditions indicated its possible presence (*6*). However, the added hyaluronic acid migrated ahead of the alligator albumin (mobility of 8.2×10^{-5} at *p*H 8.6).

Finally, it was found that the alligator globulin precipitates out in 30–40 percent saturated ammonium sulfate solutions while the albumin is soluble at 50 percent saturation.

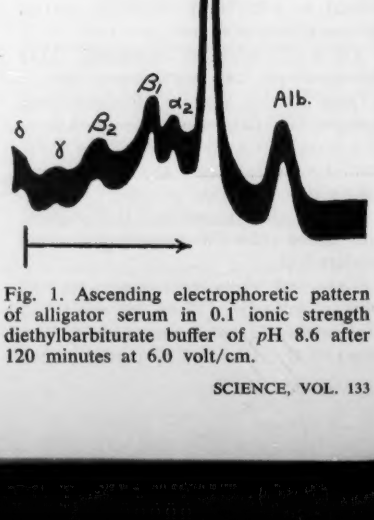


Fig. 1. Ascending electrophoretic pattern of alligator serum in 0.1 ionic strength diethylbarbiturate buffer of *p*H 8.6 after 120 minutes at 6.0 volt/cm.

The relative solubilities in ammonium sulfate, the respective sedimentation coefficients, and the relative mobilities with respect to rabbit serum, bovine serum albumin, and hyaluronic acid of the two major and leading electrophoretic components of alligator serum has led to identification of the leading component with the serum albumin and the second and largest components with serum α-globulin (*7*).

EARL F. BARIL*
JERRY L. PALMER
ALLEN H. BARTEL
Department of Biology, University of Houston, Houston, Texas

References and Notes

1. D. H. Moore, *J. Biol. Chem.* **161**, 21 (1945); H. C. Dessauer and W. Fox, *Science* **124**, 225 (1956); H. F. Deutsch and W. H. McShan, *J. Biol. Chem.* **180**, 219 (1949).
2. W. F. Sunderman, Jr., and W. F. Sunderman, *Am. J. Clin. Pathol.* **27**, 132 (1957).
3. W. Pigman, E. Gramling, D. Platt, H. L. Holley, *Biochem. J.* **71**, 201 (1959).
4. J. Kohn, *Clin. Chim. Acta* **2**, 297 (1957).
5. G. Wallenius, A. Trautman, H. G. Kunkel, E. C. Franklin, *J. Biol. Chem.* **225**, 253 (1957).
6. H. F. Deutsch, *ibid.* **224**, 771 (1957).
7. This work was partially supported by a grant (G-7448) from the National Science Foundation.
* National Science Foundation cooperative fellow.

2 September 1960

Alteration of Plasma Proteins at Metamorphosis in the Lamprey (Petromyzon marinus dosatus)

Abstract. Coincident with metamorphosis in the lamprey (*Petromyzon marinus dosatus*), a new, more rapidly moving plasma protein component appears. In the mature lamprey this new component is of major quantitative importance. With paper electrophoretic mobility as the sole criterion, the new component is considered to be an alpha globulin rather than albumin.

The striking anatomical alterations which occur during metamorphosis in vertebrates may be accompanied by equally striking, if less overt, biochemical changes. A number of such biochemical changes have been reported recently. These include the retinal pigments in various vertebrates, including the sea lamprey, and the serum proteins and nitrogen metabolism in the tadpole and the frog (*1*). In this communication we report another example of a biochemical change—an alteration in the serum proteins which accompanies metamorphosis in the sea lamprey, *Petromyzon marinus dosatus*.

Specimens of Petromyzon (*2*) were shipped by air to Washington, D.C. in insulated jugs containing ice water. All the animals were healthy and vigorous upon arrival. The larvae were 3 to 5 in. long, while the newly transformed adults were 5 to 6 in. long. These specimens had been obtained during the winter months. The mature adults (obtained in May) were captured as they were going upstream, and these animals were approximately 15 in. long.

The blood from the larvae and the newly transformed adults was obtained after parental administration of 50 μg of heparin to each animal. Twenty minutes after heparin injection the tail was amputated and the blood was aspirated from the caudal artery into a polyethylene tube with an inside diameter of 0.86 mm; 30 to 100 μl of blood was obtained from each animal. After the blood had been drawn into the polyethylene tube, the tube was folded in the shape of a U, inserted in a small-bore centrifuge tube, and centrifuged for 2 minutes. The plasma was separated by cutting the plastic tube just above the junction of cells and plasma. Blood was obtained from the mature adults by puncture of a caudal vessel either with a heparinized syringe or after administration of 1.0 mg of heparin to the animal. In all, samples were taken from at least ten larvae and newly transformed adults and three mature adults.

Paper electrophoresis was performed on 18-μl samples by using a Durrum-type cell and Veronal buffer (pH 8.6) with constant current of 2.5 ma for 18 hours. The resulting voltage was about 80. The strips were stained with bromphenol blue, and the density was analyzed with a Spinco Analytrol.

Paper-electrophoretic strips of plasma from a larva, a newly transformed adult lamprey, a mature adult lamprey, and a normal human being are shown in Fig. 1. In the newly transformed adult there appeared a small amount of protein with a higher electrophoretic mobility than any component seen in the larva. In the mature adult this new component constituted an important percentage of the plasma proteins. It did not, however, have the electrophoretic mobility of human albumin. In certain mature adult specimens there was a marked increase, seemingly related to hemolysis, in the amount of a more slowly moving component.

Human serum albumin has been used as a reference for labeling the electrophoretic components (Table 1), although it is clear that electrophoretic mobility alone is inadequate for categorizing such components. The major component in larval lamprey plasma is considered to be an alpha globulin. In adult lamprey plasma, the two strongest bands are considered to be an alpha-1 globulin and an alpha-2 globulin. In the mature lamprey the alpha-1 and alpha-2 globulins are approximately equal in concentration. It is clear that these are two separate components rather than a single large component. This scheme indicates the apparent lack in lamprey plasma of a component with the same electrophoretic mobility as mammalian albumin.

Table 1. Plasma protein components of the lamprey.

Specimen	Protein (%)				
	Albumin	Globulin			
		α_1	α_2	β	γ
	Human being				
	59	4	10	11	17
	Lamprey				
Larva	0	70		8	22
New adult	0	6	71	10	13
Mature adult	0	37	45	10	8

Wald demonstrated the changes in the retinal pigments which accompany metamorphosis in the lamprey (*1*). The development of the thyroid gland from an exocrine to an endocrine gland is another example of metamorphosis in the lamprey (*3*). To this can now be added the development of a new protein component in the plasma of the metamorphosing lamprey. This component has a greater electrophoretic mobility than any component in the larval animal. It is important to note, however, that even the adult lamprey lacks plasma albumin. This finding is consistent with the observation that certain elasmobranchs also lack a plasma component comparable to human

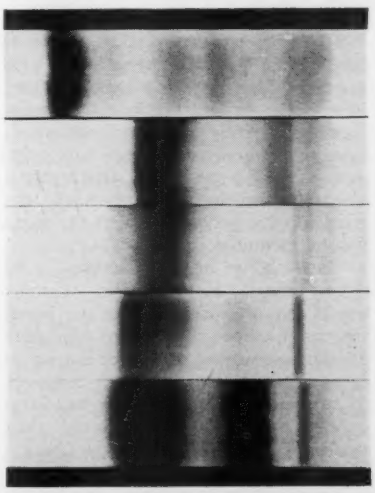


Fig. 1. Electrophoretic patterns of plasma proteins of the lamprey. The origin is to the right. The top strip represents, for comparison, 6 μl of human serum; the second strip, 18 μl of larval lamprey plasma; the third or middle strip, 18 μl of plasma from a newly transformed adult; the fourth strip, 18 μl of plasma from a mature adult lamprey; and the bottom strip, 24 μl of hemolyzed plasma from a mature adult lamprey.

albumin (*4*). It is notable that this cyclostome and certain elasmobranchs have no albumin-like component in their plasma, while teleosts in general appear to possess such an albumin-like component (*5*).

DAVID P. RALL
PAUL SCHWAB
CHARLES G. ZUBROD
National Cancer Institute,
National Institutes of Health,
Bethesda, Maryland

References and Notes

1. G. Wald, *Science* **128**, 1481 (1958).
2. The specimens were obtained through the courtesy of Dr. Vernon Applegate of the Hammond Bay Fisheries, U.S. Fish and Wildlife Service, Roger City, Mich.
3. A. Gorbman and C. W. Creaser, *J. Exptl. Zool.* **89**, 391 (1942).
4. C. G. Zubrod and D. P. Rall, *J. Pharmacol. Exptl. Therap.* **125**, 194 (1959).
5. J. B. Field, C. A. Elvehjem, C. Juday, *J. Biol. Chem.* **148**, 261 (1943); H. F. Deutsch and M. B. Goodloe, *ibid.* **161**, 1 (1945).

10 October 1960

Test of Response Bias Explanation of Word-Frequency Effect

Abstract. Observers identified monosyllabic words presented in noise. It was found that controlling response bias eliminates the word-frequency effect. However, the magnitude of the word-frequency effect was greater than that predicted by a mathematical model denying stimulus words any role in producing the word-frequency effect.

The word-frequency effect refers to the finding that observers faced with the task of identifying words presented in noise or flashed briefly on a screen identify correctly more common words than uncommon words. The more common a word is (the more frequently a word occurs in the language), the greater is the probability that the word will be identified correctly (*1*).

The response bias explanation, in its most general form, denies stimulus words any role in producing the word-frequency effect. The word-frequency effect is considered to be due merely to response bias—the observer's tendency to use more words of high word-frequency as identifying responses than words of low word-frequency (*2*).

We interpret this form of response bias explanation as implying that groups of words which differ in word-frequency are random samples from the same population of acoustical or visual parameters. In other words, response bias explanation seems to imply that intervals of word-frequency which contain the same number of words are equivalent samples. Consequently, if there are n intervals, a stimulus word from one interval may be matched, in terms of physical similarity, just as adequately by a response word from one as from another of the remaining $n - 1$ intervals.

The word-frequency effect may be derived if we take the assumption of acoustical equivalence of intervals as implying two mathematical relations:

$$p_c(s,r) = kp(s,r), \qquad s = r \qquad (1)$$

where s and r indicate the interval of the stimulus word and the response word respectively; $p(s,r)$ is the probability of a particular combination of stimulus interval and response interval, given that s equals r; $p_c(s,r)$ is the proportion of $p(s,r)$ for which the response word is correct; and k is a constant between zero and unity. This equation may be interpreted as saying that when the stimulus word and the response word are in the same interval, the probability that the response is correct is independent of the interval of the stimulus.

$$p(s,r) = bp(r) + d, \qquad s \neq r \qquad (2)$$

where $p(s,r)$ is the probability of a particular combination of stimulus interval and response interval given that s is not equal to r; $p(r)$ is the probability of a response in a particular interval; and b and d are constants. This equation is mathematically equivalent to saying that a response from a particular interval will be given just as often to words from one (different) interval as to words from another (different) interval. Equation 2 further implies that

$$p(s,r) = \frac{1}{n}\,p(r) + a, \qquad s = r \quad (3a)$$

$$= \frac{1}{n}\,p(r) - \frac{a}{(n-1)}, \qquad s \neq r \quad (3b)$$

where n is the number of stimulus or response intervals and a is a constant. Thus, Eq. 2 mathematically determines all of the n^2 probabilities of combinations of stimulus interval and response interval to within one constant, when the $p(r)$ values are known and $p(s)$ is a constant ($1/n$). Together Eqs. 1 and 2 imply that the number of words in an interval which are correctly identified is a linear function of the number of responses in the interval. That is,

$$p_c(s,r) = k\left[\frac{1}{n}\,p(r) + a\right], \quad s = r \qquad (4)$$

Thus, the word-frequency effect is derived in terms of $p(r)$—$p(r)$ supposedly being some monotonic function of the median word-frequency of the interval. The word-frequency effect, from the viewpoint of Eq. 4, must increase with a rate of k/n. In this sense, the magnitude of the word-frequency effect is predicted from Eqs. 1 and 2.

The above equations assume that $p(s)$ is a constant and that the intervals all contain the same number of different words in the language. In general, the equations assume that no physical aspect of words related to the threshold changes from interval to interval. Word length must be controlled since it has been shown to be positively related to intelligibility (*3*). This can be approximated by limiting stimulus and response words to words of the same number of syllables.

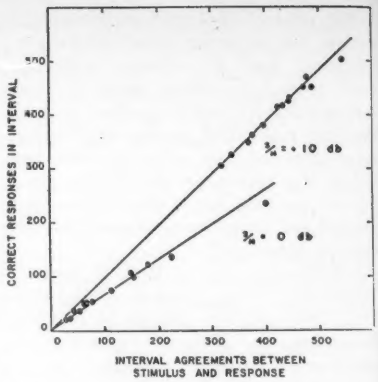


Fig. 1. Number of correct responses in an interval as a function of the number of instances where stimulus and response agree in interval [$p_c(s,r)$ versus $p(s,r)$]. In general, the greater the number of agreements, the greater the median word-frequency of the interval. The points, one for each interval, represent the sum of the data for the six observers in the group.

To test the predictions of Eqs. 1 and 4 an experiment was conducted at two speech-to-noise (S/N) ratios, 0 and +10 db. These S/N ratios resulted in an over-all probability of correct response of 0.13 and 0.68, respectively. A different group of six observers listened at each S/N ratio. Words were presented at a rate of approximately one every 10 seconds. Each observer listened for

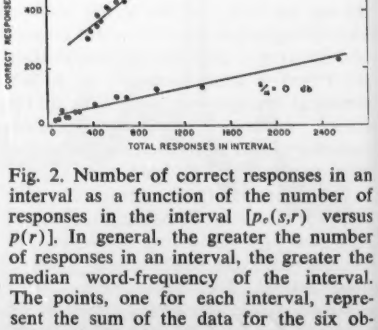


Fig. 2. Number of correct responses in an interval as a function of the number of responses in the interval [$p_c(s,r)$ versus $p(r)$]. In general, the greater the number of responses in an interval, the greater the median word-frequency of the interval. The points, one for each interval, represent the sum of the data for the six observers in the group.

about an hour a day for several days. A total of 1300 different monosyllabic content words were presented to each observer—100 words from each of 13 intervals. Within each experimental session, words were presented in a random order with respect to word-frequency, except that each interval had to be represented 12 times in each block of 156 trials. The observers were instructed to respond with a monosyllabic word.

The intervals were set up according to data obtained from the Lorge Magazine Count (*4*). There are approximately 6500 monosyllabic content words in this count; therefore, each interval permitted approximately 500 different response words. The median word-frequency of the intervals ranged from 1 to 736 (in the Lorge sample of 4.5 million word occurrences). The stimulus words were selected randomly except for the attempt to control word length.

Figure 1 shows the results in terms of Eq. 1. (The axes, however, are in terms of number rather than probability.) Figure 1 indicates that $p_c(s,r)$ is a constant proportion (k) of $p(s,r)$, or that the probability of correct response is independent of the interval of the stimulus word when the stimulus and response words agree in interval. For 0 and +10 db, k is approximately 0.63 and 0.94, respectively. Linear curves with zero intercept are drawn to indicate the excellent agreement between Eq. 1 and the data.

Figure 2 shows the results in terms of Eq. 4 (in terms of number). Figure 2 indicates that $p_c(s,r)$ is a linear function of $p(r)$, as predicted from Eq. 4. Since $p(s,r)$ differs from $p_c(s,r)$ only by the multiplicative constant k, Fig. 2 also indicates that $p(s,r)$ is a linear function of $p(r)$. Thus, the effect of response bias—the tendency for $p(r)$ to increase with the median word-frequency of the interval—is to increase $p(s,r)$.

Figures 1 and 2 support the response bias explanation by implying that response bias is a necessary condition for the word-frequency effect. When $p(r)$ increases with the median word-frequency of the interval—and this is what we mean by response bias—$p(s,r)$ also increases, and since $p_c(s,r)$ is proportional to $p(s,r)$, the word-frequency effect is obtained. The result of controlling response bias is to eliminate the word-frequency effect, as can be seen from the fact that $p_c(s,r)/p(s,r)$ is a constant (Fig. 1). Thus words of high word-frequency are not identified more accurately than words of low word-frequency when response bias is controlled.

Even though response bias accounts fully for the word-frequency effect, the magnitude of the obtained effect is greater than our mathematical interpretation of response bias explanation (Eqs. 1 and 2) can account for. The slopes obtained in Fig. 2 are considerably greater than the predicted slopes (k/n). Values of 0.31 and 0.08 were obtained for +10 and 0 db, respectively, while 0.07 and 0.05 were predicted. This means that an increase in $p(r)$ results in too great an increase in $p(s,r)$ and, therefore, too great an increase in $p_c(s,r)$. If Eqs. 1 and 2 are accepted as the appropriate interpretation of acoustical equivalence, the implication seems to be that, contrary to the contention of response bias explanation, words do carry some acoustical information about their interval (*5*).

CHARLES R. BROWN
HERBERT RUBENSTEIN
Air Force Command and Control Development Division, L. G. Hanscom Field, Bedford, Massachusetts

References and Notes

1. D. Howes and R. L. Solomon, *J. Exptl. Psychol.* **41**, 401 (1951); M. R. Rosenzweig and L. Postman, *Science* **127**, 263 (1958).
2. ———, *J. Exptl. Psychol.* **54**, 412 (1957); I. Goldiamond and W. F. Hawkins, *ibid.* **56**, 457 (1958).
3. J. P. Egan, *Laryngoscope* **58**, 955 (1948).
4. E. L. Thorndike and I. Lorge, *The Teacher's Word Book of 30,000 Words* (Teachers College, Columbia University, New York, 1944). Actually we took advantage of a revised listing by frequency, which was kindly lent to us by Davis Howes of Massachusetts Institute of Technology.
5. This is technical report No. AFCCDD TR-60-34 of the Air Force Command and Control Development Division. This research supports project 7684, communication in noise, of the Air Research and Development Command's program in human performance.

3 October 1960

Relation between the Inorganic Chemistry and Biochemistry of Bone Mineralization

Abstract. In vitro experiments with saliva resulted in precipitation of a mineral substance (dahllite or carbonate hydroxyapatite) which is comparable in composition and crystal structure to oral calculus. Similar mineral substances were produced from synthetic solutions containing sodium phosphate and calcium chloride (in addition to a buffer) in the presence of carbonic anhydrase and available carbon dioxide. It is concluded that the carbonate ion is essential to precipitation of bone mineral and that the principal biochemical catalyst in vivo is carbonic anhydrase. Bacteria are not essential to the precipitation, but they probably play a secondary role in connection with the formation of oral calculus, urinary calculus, and so forth.

On the basis of an understanding of the inorganic composition and crystal chemistry of the tooth and bone mineral (*1*), it was predicted (i) that the carbonate (or bicarbonate) ion is essential to the precipitation of the bone mineral, (ii) that the presence of a bacterial flora is not essential, and (iii) that some single biochemical substance, such as an enzyme, might catalyze the reaction and thereby govern whether or not mineralization takes place. The enzyme which immediately attracts attention is carbonic anhydrase.

Fig. 1. Plummets immersed intermittently in (left to right): untreated whole saliva, saliva inactivated by heating, saliva to which carbonic anhydrase was added after heating, and saliva to which carbonic anhydrase and sulfanilamide were added after heating.

Inasmuch as the mineral substance of the commonest type of oral calculus is dahllite (a carbonate hydroxyapatite)—and therefore essentially similar to bone and tooth mineral—it was decided to investigate in vitro those processes which are related to the formation of oral calculus.

Our first experiment consisted of repeatedly dipping small glass plummets into saliva by means of a motor-driven apparatus. The saliva was collected from persons who readily accumulated calculus. After 5 days an appreciable deposit appeared on the glass plummet which was intermittently immersed in untreated saliva (see Fig. 1). After the saliva had been boiled, the amount of solid deposited on the plummet was insignificant. However, if crystalline carbonic anhydrase was added to the saliva for which the enzyme had been inactivated by heating, again a heavy precipitate formed on the glass plummet. If, in addition to the enzyme, sulfanilamide was added to inhibit the activity of the enzyme (*2*), virtually no deposit was formed. During the course of these experiments the only source of carbon dioxide, other than what was initially present in the saliva and was not removed by heating, was laboratory air.

Two additional sets of experiments were particularly informative. Both of these were done with solutions containing sodium phosphate and calcium chloride. Although the solutions were not sterilized, no significant bacterial contamination could have occurred. First it was discovered that when the solutions were saturated with carbon

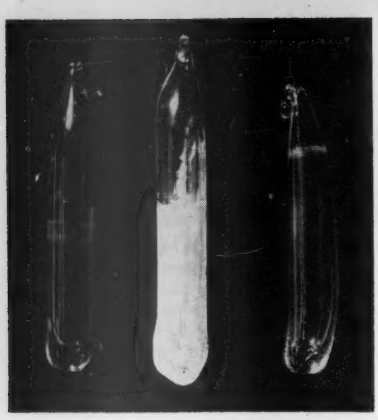


Fig. 2. Plummets immersed intermittently in synthetic solutions in an atmosphere of carbon dioxide (left to right): without enzyme, with enzyme, and with enzyme and inhibitor.

dioxide by bubbling the gas through them, the enzyme was not required in order for a deposit to form. These solutions presumably lost carbon dioxide until an optimum concentration of carbonate ions and *p*H favored precipitation.

However, when these synthetic solutions were not initially saturated with carbon dioxide and when the apparatus was enclosed in an atmosphere of carbon dioxide, the results (Fig. 2) were essentially similar to those obtained with boiled saliva: that is, no significant deposit was obtained unless carbonic anhydrase was added, and addition of sulfanilamide prevented formation of a deposit. These solutions contained also an organic buffer. The initial *p*H was 7.5 and no appreciable change took place accompanying the deposition.

In all cases the mineral depositions probably consisted of microcrystalline dahllite. By means of x-ray diffraction methods this fact was verified for three precipitates: the only deposit obtained from the second set of experiments with synthetic solutions (the one containing carbonic anhydrase) and the two significant deposits obtained with saliva (untreated saliva and boiled saliva to which carbonic anhydrase had been added). No evidence of the presence of a second crystalline phase was obtained (Fig. 3), but this does not necessarily prove that the nascent deposition has the crystal structure of an apatite. It merely proves that the stable inorganic substance in such a system is a carbonate hydroxyapatite (*3*), regardless of any inorganic precursor which might have existed (*4*).

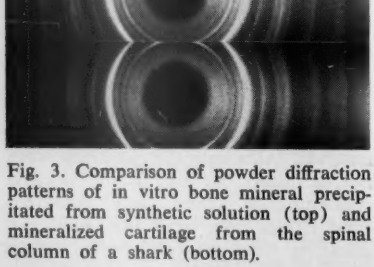


Fig. 3. Comparison of powder diffraction patterns of in vitro bone mineral precipitated from synthetic solution (top) and mineralized cartilage from the spinal column of a shark (bottom).

DUNCAN MCCONNELL
WALTER J. FRAJOLA
DAVID W. DEAMER

Health Center,
Ohio State University, Columbus

References and Notes

1. D. McConnell, *J. Dental Research* **31**, 53 (1952); *Am. Mineralogist* **45**, 209 (1960); *Arch. Oral Biol.* (1961), in press.
2. G. W. Rapp, *J. Am. Dental Assoc.* **33**, 191 (1946).
3. The carbonate content of an apatite cannot necessarily be demonstrated by x-ray diffraction methods for microcrystalline materials, but it was confirmed by liberation of bubbles of gas during dissolution of the deposits in hydrochloric acid.
4. The specimen of mineralized connective tissue of a shark, which we find to be crystallochemically identical with bone, was supplied by Dr. Marshall R. Urist, Department of Surgery, University of California Medical Center, Los Angeles. The diffraction pattern indicates preferential orientation of the crystallites because the specimen was not powdered but was merely cut in the shape of a rod.
This investigation was supported by a grant to the Ohio State University Research Foundation by the Procter & Gamble Co., Cincinnati.

26 September 1960

Relations between Whitefly and Sweetpotato Tissue in Transmission of Yellow Dwarf Virus

Abstract. One approach revealed the nature of the piercing-sucking-feeding mechanism of the abutilon whitefly, *Trialeurodes abutilonea*, a new vector of sweetpotato yellow dwarf virus. It showed the complete stylet from its origin in the rostrum to its termination in the plant's translocation stream. Another approach clearly delineated and confirmed the life cycle of the abutilon whitefly in relation to physical function and duration of each of the six stages.

Observations of sweetpotato plantings at Beltsville, Md., in 1955 and 1956, revealed relatively low percentages of natural spread of feathery mottle virosis. None of the leafhoppers in the same location were found to be vectors of the disease. In 1957 the abutilon whitefly, *Trialeurodes abutilonea* (Hald.), was found living on Indian Mallow, *Abutilon theophrasti* Medic. When an August drouth defoliated the weed, this insect was forced off the weed and onto the sweetpotato. It was subsequently revealed to be a new virus vector (*1*).

Bennett (*2*) was probably the first to report on the tissue relations of a plant virus vector. By means of a camera-lucida drawing the stylet of the sugar beet leafhopper was shown in feeding position for transmission of curly-top virus. Fife and Frampton (*3*) demonstrated how the vector of curly-top utilizes the *p*H gradient for passing its stylet through the "acid" parenchyma into the "alkaline" phloem tissue, where it feeds.

The tobacco whitefly, *Bemisia tabaci* (Genn.), is known as a vector of several viruses in the subtropics. Pollard (*4*) studied its feeding habits in the Egyptian Sudan of Africa, where it spreads the cotton leaf curl virus and also causes other damage to cotton. In his anatomical studies a large majority of the insect stylets were observed penetrating to the depth of the phloem. His camera-lucida drawing showed the stylet in feeding position. It had perforated the epidermis and penetrated between the cells to the depth of the phloem. As pointed out by Avidov (*5*), this adult whitefly is well-qualified as a virus vector in Israel, where it is active about 5 weeks in the summer and 10 weeks in the winter. The same insect, *B. tabaci*, was also reported to be the vector of sweetpotato virus B in East Africa by Sheffield (*6*); subsequently, Girardeau (*7*) found that *B. tabaci* was the vector of a sweetpotato mottle mosaic in Georgia.

Concurrently, it was discovered (*1, 8*) that the whitefly, *Trialeurodes abutilonea* (Hald.), was the natural vector of sweetpotato yellow dwarf (feathery mottle) in Maryland; yellow dwarf is probably the same disease as was reported from Africa, Israel, and Georgia (*6, 7, 9*).

Direct micrurgical examination of the abutilon whitefly preceded the anatomical studies of the fixed material. The adult was the first and only stage of *T. abutilonea* observed in the field at Beltsville in late June each year since 1957. This means that pupae are the overwintering stage.

After the crawlers had been hatched, ordinarily they had stopped moving around and were feeding within an hour. After 2 days the rooted cuttings were ready for planting in peat pots for observation of the subsequent stages of development in the insect's life cycle. During 1958, five to ten larvae were transferred onto each of 50 lots of diseased cuttings and carried through to maturity with a percentage survival of 65. These transfer studies were repeated during 1959 and 1960, with essentially the same results.

A time interval of about 3 days was

noted as the span for each of the six stages (including the egg) of the life cycle of the abutilon whitefly, for a generation time of 18 days; but by mid-September the interval had increased to 4 days, to extend the generation time to 28 days. During the latter half of September, the biological activity of the active stages of this insect changed abruptly. By the end of the month none of the pupae had become adults, practically none of the eggs had hatched, and all activity had ceased.

The generation time and breeding activity of the nonvector greenhouse whitefly, *T. vaporariorum* (Westw.), were practically identical to that of the abutilon whitefly vector during the growing season until toward the end of September when instead of stopping it only slowed down and continued activity until frost.

Microscopic examination revealed that once the first larval or crawler stage comes to rest and inserts its stylet into feeding position, the body ceases to use its legs, which are then shed with the skin during metamorphosis into the second larval stage.

The stylet of the first larval stage of the abutilon whitefly appeared to be of uniform size throughout its length and measured about 1.6 μ in diameter, whereas the adult stylets measured about 2.2 μ in diameter.

According to Hargreaves (*10*), the stylets of all larvae and adults of the greenhouse whitefly consist of two tubes composed of two mandibles and two maxillae. The stylets of some larvae may be withdrawn within the body.

Transmission experiments involved the transfer of three or more adults from the source or location of the pupal cases on the diseased plant to the new feeding site on a healthy plant. Positive transmission was obtained in a few instances—or less than 20 percent of the time—when the viruliferous adults survived a day or longer after transfer.

Anatomical studies were necessitated when the micrurgical method failed to clarify the role of the larval stylet in relation to pathogenesis of sweetpotato tissue. In preparation, the three larval stages of *T. abutilonea* were collected and fixed. Three different fixing fluids were used: (i) Newcomer's (*11*), (ii) formalin-acetic acid-alcohol, and (iii) formalin-propionic acid-alcohol. The third fixing fluid proved best. Before the material was fixed, the sweetpotato leaf tissue was cut into oblong rectangular pieces with the larvae oriented lengthwise to facilitate making cross and longitudinal sections. The tissue was dehydrated in tertiary butyl alcohol, embedded in paraffin (55°C), sectioned about 12 μ thick, and stained with Flemming's triple stain.

Fig. 1. Cross section of a larva in feeding position on the underside of a sweetpotato leaf. Its sheathed stylet is exposed to view throughout its length by a stained gelatinous secretion. [H. Dermen]

Figure 1 is a microtome cross section which shows an abutilon whitefly second-stage larva in feeding position with its stylet exposed to view throughout its length and ending in a host cell. To observe the full length of a stylet from the rostrum to the depth of the phloem required the examination of several hundred sections before a perfect or complete specimen was found. Examination of numerous histological sections revealed that the larval stylets invariably end in phloem tissue and almost always in the cells of the plant's translocation stream. Fortunately the intercellular channel of the tiny stylet is made conspicuous by the stained gelatinous sheath with which it is clothed.

Figure 2 is another excellent specimen of penetration—a longitudinal section of a third-stage larva in feeding position, with its stylet exposed to view throughout its length. As in Fig. 1, the stylet pathway is made conspicuous by its gelatinous sheath. The section was stained very lightly so as not to obscure the path of the stylet from its origin to its termination.

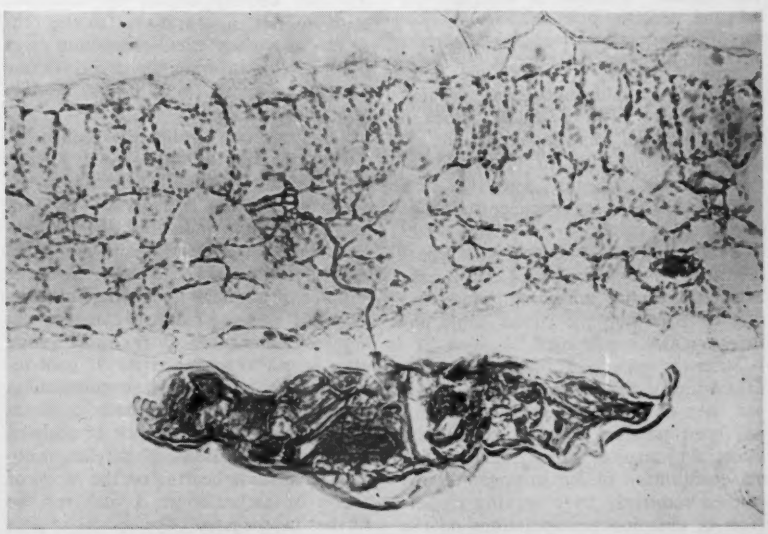


Fig. 2. Longitudinal section of a larva in feeding position with the sheathed stylet completely in view from the rostrum to the stylet's termination at a cell in the plant's translocation stream. [H. Dermen]

This histological study revealed some of the minute details of the vector-virus-host relationship of the sweetpotato yellow dwarf virosis and demonstrated the precision of the surgical operation performed by this insect in its normal feeding operations. Other unreported evidence supports the hypothesis, which definitely applies to all whiteflies and aphids, that whenever a stylet is less than 3 μ in diameter penetration will be intercellular, because its physical size makes it too limber for direct penetration.

E. M. HILDEBRAND
Agricultural Research Service,
U.S. Department of Agriculture,
Beltsville, Maryland

References

1. E. M. Hildebrand, *Plant Disease Reptr.* **43**, 712 (1959).
2. C. W. Bennet, *J. Agr. Research* **48**, 665 (1934).
3. J. M. Fife and V. L. Frampton, *ibid.* **53**, 581 (1936).
4. D. G. Pollard, *Ann. Appl. Biol.* **43**, 664 (1955).
5. Z. Avidov, *Agricultural Research Station, Rehovat, Israel* **7**, 275 (1956).
6. F. M. Sheffield, *Phytopathology* **47**, 582 (1957).
7. J. H. Girardeau, *Plant Disease Reptr.* **42**, 819 (1958).
8. E. M. Hildebrand, *ibid.* **43**, 715 (1959).
9. G. Loebenstein and I. Harpaz, *Phytopathology* **50**, 100 (1960).
10. E. Hargreaves, *Ann. Appl. Biol.* **1**, 303 (1915).
11. E. H. Newcomer, *Science* **118**, 160 (1953).

5 December 1960

Chemical Nature of Antheridogen-A, a Specific Inducer of the Male Sex Organ in Certain Fern Species

Abstract. Antheridogen-A has been shown to be a complex carboxylic acid. The carboxyl function is necessary for inductor activity since this activity disappears on esterification and reappears after hydrolysis of the ester.

Recently a substance was isolated from culture filtrates of the bracken fern *Pteridium aquilinum* which induces the formation of antheridia in gametophytes of the sensitive fern *Onoclea sensibilis* at a concentration of less than 1 part in 10,000,000,000 (10^{-4} μg/ml) (*1*). The present report describes what is known of the chemical nature of this antheridium-inducing factor, for which the trivial name antheridogen-A is proposed.

Since the material is present at a concentration of the order of 1 μg or less per liter of culture filtrate, it has not yet been possible to produce enough material to analyze directly. The chemical constitution of antheridogen-A was studied indirectly by observing the effects of chemical manipulations on the purified concentrate prepared as previously described (*1*). Antheridogen-A dialyzes readily through cellophane membranes, so it appears to have a low molecular weight. It is relatively stable in acid solution but is readily inactivated at *p*H above 7. It is also readily inactivated by oxidizing agents. During the course of isolation the compound behaved as a weak acid.

Antheridogen-A was found to have a distribution coefficient close to unity when partitioned between normal butanol and 5 percent ammonium acetate buffer of *p*H 6.65 (*1*). When partitioned between ethyl acetate, isoamyl acetate, tertiary amyl alcohol, or peroxide-free diethyl ether and McIlvaine buffers at various *p*H's, antheridogen-A distributed in a pattern which suggested it to have a pK_a of about 5.0.

The compound appears to be free of phosphorus. When an amount of material equivalent to 10 μg was tested by the method of Hanes and Isherwood (*2*) no color was produced. All phosphate esters tested at this concentration gave strong positive tests. Ninhydrin tests on filter paper chromatograms of the material were consistently negative.

Treatment of a dry ethereal solution of antheridogen-A with excess diazomethane completely inactivated the material. When the methyl ester was refluxed with 5*N* hydrochloric acid for 3 hours, biological activity was restored.

Examination of the infrared absorption spectrum of antheridogen-A preparations revealed a well-defined maximum at 1700 cm^{-1} which is consistent with a carboxyl functional group and perhaps suggests that the molecule contains an unsaturated carbon-carbon bond in the vicinity of the carboxyl group (*3*). The ease with which the inductor activity is lost by oxidation also suggests unsaturation. On the other hand, when the compound was treated with bromine in carbon tetrachloride solution for 4 hours, no loss of activity occurred.

The preceding indirect evidence indicates that antheridogen-A is a complex carboxylic acid. Furthermore, the carboxyl function is necessary for biological activity since this activity disappears on esterification and reappears after hydrolysis of the ester. A large number of naturally occurring carboxylic acids were tested for antheridium-inducing activity on *O. sensibilis*. None were found to have activity. It is of interest to note that certain long-chain aliphatic fatty acids produce a threefold increase in the potency of antheridogen-A preparations. This relationship may have some bearing on the mode of action of antheridogen-A and will be further investigated (*4*).

ROSS B. PRINGLE
Rockefeller Institute,
New York, New York

References and Notes

1. R. B. Pringle, U. Näf, A. C. Braun, *Nature* **186**, 1066 (1960).
2. C. S. Hanes and F. A. Isherwood, *ibid.* **164**, 1107 (1949).
3. L. J. Bellamy, *The Infra-red Spectra of Complex Molecules* (Methuen, London, ed. 2, 1958), p. 161.
4. This investigation was supported in part by a National Science Foundation research grant (G-6144).

30 September 1960

Maintenance of Avoidance Behavior under Temporally Defined Contingencies

Abstract. Operant behavior of rats was maintained at moderate frequencies by a temporally defined shock avoidance schedule. Progressive reductions in one of the temporal parameters of this schedule—the portion during which behavior may have consequences—yield an orderly response rate function which first rises to a maximum and then declines gradually to extinction.

A system for classifying schedules of reinforcement for operant behavior in terms of temporally defined parameters has recently been proposed by Schoenfeld, Cumming, and Hearst (*1*). This system, which provides a common dimensional framework for the specification of reinforcement schedules generally, defines two basic variables: t^D and t^A, time periods during which, respectively, reinforcement may be given and reinforcement is never given.

Conventionally, t^D and t^A are held constant and are alternated, and only the first response in t^D is reinforced. Some of the parameters of that system have been experimentally explored in a number of recent studies (*2*) in which positive reinforcement procedures were employed, but to date their effects have not been observed in avoidance conditioning contexts, where the occurrence of a given response prevents the presentation of an aversive stimulus. In the procedure adopted in the experiment reported here, an avoidance schedule lacking a warning stimulus (*3*) was cast in t^D, t^A terms, and the effects of systematically varying one of the temporally defined parameters were studied.

Four adult male hooded rats, all without prior experimental history, were exposed for 30 minutes daily to an avoidance conditioning schedule. The sound-resistant chamber in which all the animals worked was equipped with a lever and a grid floor through which electric shock (0.3 ma) could be delivered to the rat's feet. Depression of the lever activated counters and a cumulative recorder. Relays and timers established a temporally defined avoidance schedule composed of alternating t^A and t^D time periods, one following

the other in such a way that a complete cycle $t^A + t^D = T = k = 30$ seconds. In t^D, the first lever press made by the rat enabled it to avoid shock; in t^A, lever presses were without effect. Therefore, at the beginning of each $t^A + t^D$ cycle, shock occurred unless a response had been made in the immediately preceding t^D period. Lever presses occurring during shock terminated the shock, but except for this escape contingency, responses in t^A portions of the 30-second cycle had no effect on the schedule.

The animals were first exposed to 22 consecutive sessions at $t^A + t^D = 30$ seconds, $t^A = 0$ to allow their response rates to stabilize; t^D was then progressively reduced over the course of the experiment from 30 seconds to 15, 7.5, 3.75, 1.8, and 0.4 seconds. The animals were given 13 sessions of exposure at each of these t^D values except 0.4 second. At $t^D = 0.4$ second, extinction of the avoidance response appeared to be complete by the eighth session, and the experiment was therefore terminated at that time.

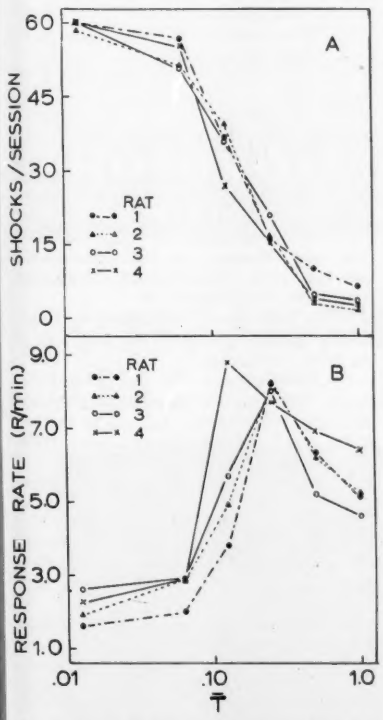


Fig. 1. (*A*) Number of shocks received per session; (*B*) lever-press response rates for four rats as a function of the temporal schedule parameter $\overline{T}$. $\overline{T}$ is defined as $t^D/(t^D + t^A)$ and represents here the relative portion of a 30-second shock-shock interval in the period during which the first response resulted in avoidance of the next shock due.

Figure 1, *A* and *B*, illustrates for each of the four rats the number of shocks received per session and the rate of lever pressing as a function of progressive reduction in t^D. The data are averages for the final 3 days on each schedule and have been plotted against the variable $\overline{T} = t^D/(t^D + t^A)$, the relative proportion of the complete cycle for the t^D period.

The response rate functions are similar for each animal; rats 1, 2, and 3 exhibit a maximum of between 8.0 and 9.0 responses per minute at $t^D = 7.5$ seconds ($\overline{T} = 0.25$), and rat 4 a maximum at $t^D = 3.75$ seconds ($\overline{T} = 0.12$). The rates then decline over the remaining t^D values to the asymptotic shock escape rate of 2.0 responses per minute at the smallest t^D. The rate function is not related in a simple way to the number of shocks received, for, as Fig. 1*A* shows, this latter variable bears a constant inverse relationship to $\overline{T}$ throughout the range.

Cumulative records for one rat, obtained from the final session at each t^D value (except $t^D = 0.4$ second, the value at which there was no avoidance behavior), are shown in Fig. 2 (due to a recording failure a bit each session is omitted at $\overline{T} = 0.12$ and 0.06). The records reveal a roughness in over-all character and sections of negative acceleration terminated by the delivery of the aversive stimulus. Visual inspection of these records shows that little systematic change in the qualitative aspects of the rate occurs with changes in t^D.

These findings may be compared with recent data reported by Hearst (*4*) in which similar changes in the length of a t^D period within a constant cycle length of 30 seconds were made under conditions of positive food reinforcement. The rather similar rate functions that result in the two cases indicate that the effect of $\overline{T}$ reductions on response rate is a general one. The first decreases in $\overline{T}$ lead to a compensatory rate increase, but when t^D is decreased below the minimum interresponse time, responding cannot be sustained.

The procedure described here might be expected to lead to the formation of a temporal discrimination at $\overline{T}$ values

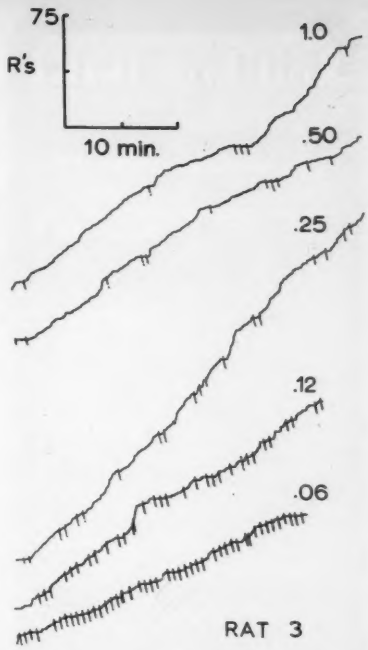


Fig. 2. Cumulative response records of lever pressing for one rat at each of six values of $\overline{T}$. Shocks are indicated by short oblique strokes, and each complete segment represents data from the final session at each $\overline{T}$ value.

at which a fairly large period of zero probability for reinforcement occurs and the average rate continues to be well sustained. The resolution of the cumulative records of Fig. 2, however, is not of sufficient detail to establish such a discrimination unequivocally; hence, a definitive answer must await a more refined within-cycle interresponse analysis of the behavior (*5*).

H. M. B. Hurwitz
J. R. Millenson

Animal Behavior Laboratory, Birkbeck College, University of London, London, England

References and Notes

1. W. N. Schoenfeld, W. W. Cumming, E. Hearst, *Proc. Natl. Acad. Sci. U.S.* **42**, 563 (1956).
2. A summary of these studies may be found in W. N. Schoenfeld and W. W. Cumming, *ibid.* **46**, 753 (1960).
3. M. Sidman, *Science* **118**, 157 (1953); see also F. Mechner, *J. Exptl. Anal. Behavior* **2**, 142 (1959).
4. E. Hearst, *J. Exptl. Anal. Behavior* **3**, 49 (1960).
5. This work was supported by funds made available by the Medical Research Council, United Kingdom.

30 September 1960

BIOCHEMISTS

RESEARCH

Challenging positions are available for Biochemists with a B.S. or M.S. degree and some research experience in protein and carbohydrates.

These positions offer an opportunity to use your initiative and creative ability on interesting and varied programs. Excellent employee benefits include tuition free graduate study. Please send resume to E. B. Beck.

ARMOUR RESEARCH FOUNDATION

OF ILLINOIS INSTITUTE OF TECHNOLOGY
10 W. 35th ST. • CHICAGO 16, ILLINOIS

STEREOSCOPIC MICROSCOPE

for the budget-minded!

Designed and sturdily built for educational or industrial use, UNITRON Model MSL has the same optical and mechanical features found in higher priced instruments.

- Erect, three-dimensional image
- Coated optics and prisms
- Achromatic 2X paired objectives, paired wide field eyepieces
- Working distance 75mm.
- Vertical binocular body with interpupillary and diopter adjustments
- Total focusing excursion 70mm.
- Heavy base, removable glass stage plate, stage clips
- Choice of one magnification 10X, 20X or 30X, extra eyepieces available

Complete in fitted hardwood cabinet ....

FREE 10 DAY TRIAL

$110.00 FOB Boston

ALSO AVAILABLE

Model MSL-A with magnifications — 5X or 10X or 15X $120.00
Extra eyepieces ..... Pair $19.50
Model LS Stereoscopic Microscope Lamp $14.75

UNITRON

INSTRUMENT DIVISION of UNITED SCIENTIFIC CO.
204-206 MILK STREET • BOSTON 9, MASS.

Please rush to me, UNITRON's Microscope Catalog 4-K-4
Name_____
Company_____
Street_____
City_____ State_____

Meetings

Forthcoming Events

February

6–8. American Acad. of Allergy, 17th annual, Washington. D.C. (J. O. Kelly, 756 N. Milwaukee St., Milwaukee 2, Wis.)

6–8. Geodesy in the Space Age, symp., Ohio State Univ., Columbus. (W. A. Heiskanen, Ohio State Univ., 1314 Kinnear Road, Columbus 12)

6–10. British Medical Assoc., annual, Auckland, New Zealand (E. Grey-Turner, B.M.A., Tavistock Sq., London, W.C.1)

9–15. Second Allergy Conf., Nassau, Bahamas. (I. M. Wechsler, P.O. Box 1454, Nassau)

13–16. American Soc. of Heating, Refrigerating and Air-Conditioning Engineers, Chicago, Ill. (R. C. Cross, 234 Fifth Ave., New York 1)

14–15. Conference on Microdosimetry, 2nd, Rochester, N.Y. (N. Kreidl, Bausch & Lomb Optical Co., Inc., Rochester 2)

15–17. International Solid-State Circuits Conf., Philadelphia, Pa. (J. J. Suran, Bldg. 3, Room 115, General Electric Co., Electronics Park, Syracuse, N.Y.)

16–18. Biophysical Soc., annual, St. Louis, Mo. (W. Sleator, Dept. of Physiology, Washington Univ., St. Louis 10)

22–25. American Educational Research Assoc., annual, Chicago, Ill. (G. T. Buswell, 1201 16th St., NW, Washington 6)

23–25. Fifteenth Annual Symp. on Fundamental Cancer Research, Houston, Tex. (Publications Dept., Univ. of Texas M.D. Anderson Hospital and Tumor Inst., Texas Medical Center, Houston 25)

23–25. Symposium on Molecular Basis of Neoplasia, Houston, Tex. (Publications Dept., Texas Medical Center, Houston 25)

26–1. American Inst. of Chemical Engineers, natl., New Orleans, La. (F. J. Van Antwerpen, AICHE, 25 W. 45 St., New York 36)

26–2. American Inst. of Mining, Metallurgical, and Petroleum Engineers, annual, St. Louis, Mo. (AIME, 29 W. 39 St., New York 18)

27–3. Conference on Analytical Chemistry and Applied Spectroscopy, 12th, Pittsburgh, Pa. (L. P. Melnich, U.S. Steel Corp., Monroeville, Pa.)

March

2–4. Optical Soc. of America, spring meeting, Pittsburgh, Pa. (Miss M. Warga, 1155 16th St., NW, Washington 6, D.C.)

2–5. National Wildlife Federation, 25th annual, Washington, D.C. (Natl. Wildlife Federation, 1412 16th St., NW, Washington 6)

5–9. Gas Turbine Conf. and Products Show, 6th annual, Washington, D.C. (Meetings Dept., American Soc. of Mechanical Engineers, 29 W. 39 St., New York 18)

6–8. North American Wildlife and Natural Resources Conf., 26th, Washington, D.C. (C. R. Gutermuth, Wildlife Management Inst., 709 Wire Bldg., Washington 5)

7–9. American Railway Engineering Assoc., annual, Chicago, Ill. (N. D. Howard, 59 E. Van Buren St., Chicago 5)

8–10. Instrument Soc. of America Conf., 11th annual, Pittsburgh, Pa. (R. R. Webster, 900 Agnew Ave., Pittsburgh 30)

8–11. Neurosurgical Soc. of America, Boca Raton, Fla. (R. K. Thompson, 803 Cathedral St., Baltimore 1, Md.)

9–10. Magnetohydrodynamics, symp. on engineering aspects of, Philadelphia, Pa. (N. W. Mather, Project Matterhorn, P.O. Box 451, Princeton, N.J.)

12–17. American College of Allergists, annual, Dallas, Tex. (P. Gottlieb, 818 Medical Arts Bldg., Philadelphia, Pa.)

13–17. National Assoc. of Corrosion Engineers, annual, Buffalo, N.Y. (W. A. Mapler, 18263 W. McNichols Rd., Detroit 19, Mich.)

13–24. Radiological Health, course in, Cincinnati, Ohio. (Chief, Training Program, Sanitary Engineering Center, 4676 Columbia Parkway, Cincinnati 26)

14–16. Clinico-Pathological Significance of Renal Biopsy, Ciba Foundation symp. (by invitation only), London, England. (Ciba Foundation, 41 Portland Place, London, W.1)

14–16. Inter-Station Supersonic Track Conf., 6th symp., China Lake, Calif. (U.S. Naval Ordnance Test Station, Code 307, China Lake, Calif.)

15–17. Medical Photography and Cinematography, intern. cong., Cologne, Germany. (Deutsche Ges. für Photographie, Neumarkt 49, Cologne)

16–17. Textile Engineering Conf., American Soc. of Mechanical Engineers, Clemson, S.C. (ASME Meetings Dept., 29 W. 39 St, New York 18)

16–18. Aviation/Space Education, 5th natl. conf., Washington, D.C. (Natl. Aviation Education Council, 1025 Connecticut Ave., NW, Washington 6)

17–19. International Medical Conf., Liège, Belgium. (Medical Commission of the FIR, Castellezgasse 35, Vienna II)

19–25. American Soc. of Photogrammetry, American Cong. on Surveying and Mapping, Washington, D.C. (C. E. Palmer, ASP, 1515 Massachusetts Ave., NW, Washington 5)

20–22. American Physical Soc., Monterey, Calif. (W. A. Nierenberg, Univ. of California, Berkeley 4)

20–23. Institute of Radio Engineers, 1961 intern. convention, New York, N.Y. (E. K. Gannett, IRE, 1 E. 79 St., New York 21)

20–24. American Surgical Assoc., Boca Raton, Fla. (W. A. Altemeier, Cincinnati General Hospital, Cincinnati 29, Ohio)

20–24. National Health Council, forum and annual meeting, New York, N.Y. (NHC, 1790 Broadway, New York 19)

20–24. Western Metal Cong. and Exposition, 12th, Los Angeles, Calif. (A. R. Putnam, American Soc. for Metals, Metals Park, Ohio)

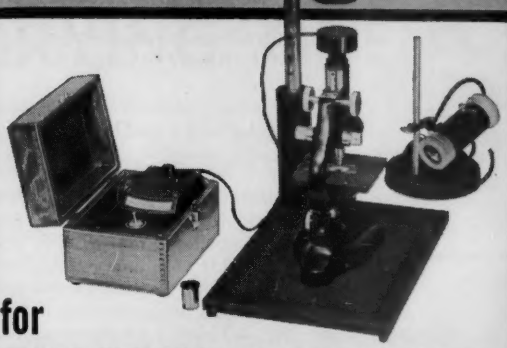
21–23. American Meteorological Soc., general meeting, Chicago, Ill. (E. P. McClain, Dept. of Meteorology, Univ. of Chicago, Chicago 37)

21–23. American Physical Soc., Division of High-Polymer Physics, 21st, Monterey, Calif. (D. W. McCall, Bell Telephone Laboratories, Murray Hill, N.J.)

21–23. American Power Conf., 23rd annual, Chicago, Ill. (W. C. Astley, Philadelphia Electric Co., 900 Sansom St., Philadelphia 5, Pa.)

(See issue of 20 January for comprehensive list)

PHOTOVOLT
EXPOSURE PHOTOMETER
Mod. 200-M



for PHOTOMICROGRAPHY

Accurate determination of exposure time in black-and-white and color photomicrography

Write for Bulletin #810 to **Price $125.00**

PHOTOVOLT CORP.
95 Madison Ave. New York 16, N. Y.

Powerful New Research Tool!

MASS SPECTROMETER NOW AVAILABLE WITH BENDIX-BUILT KNUDSEN CELL

When coupled with the new Bendix Knudsen Cell Sample Inlet System, the Bendix® Time-of-Flight Mass Spectrometer's capabilities are greatly extended. This combination can determine vapor pressures, heats of vaporization, and other thermodynamic properties of materials which have vapor pressures as low as 10^{-9} atmospheres at 2500°K.

Any Bendix Mass Spectrometer equipped with this new optional inlet system retains all of the famous Bendix versatility and high performance characteristics, such as 10,000 analyses per second, 1 to 5000 mass range, adjacent mass resolution beyond 200 a.m.u., simultaneous oscilloscope and multi-channel recorder presentation, three independent sample inlets (two of them line-of-sight), and five-parts-per-million sensitivity.

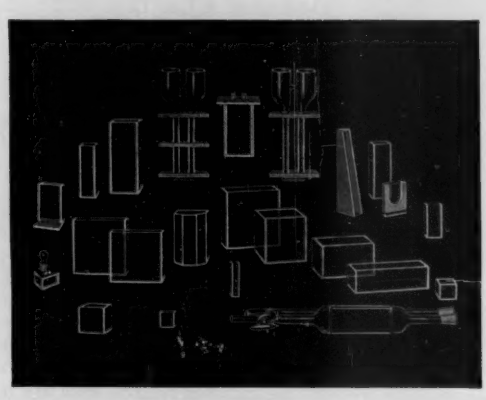
Results with the Bendix Mass Spectrometer–Knudsen Cell combination are equal to those obtained by the most famous research workers in this field, using equipment costing several times as much. Learn its advantages on your research problems. Write Department E127 for our new Bulletin MS-6.

Cincinnati Division
3130 Wasson Road • Cincinnati 8, Ohio

THE Bendix CORPORATION

Export Sales: Bendix International Division, 205 East 42nd Street, New York 17, N. Y.
Canada: Computing Devices of Canada, Ltd., Box 508, Ottawa 4, Ontario.

GLASS ABSORPTION CELLS made by ***KLETT***



SCIENTIFIC APPARATUS
Klett-Summerson Photoelectric Colorimeters—Colorimeters — Nephelometers — Fluorimeters—Bio-Colorimeters — Comparators — Glass Standards—Klett Reagents.

Klett Manufacturing Co.
179 East 87 Street, New York, New York

New Products

The information reported here is obtained from manufacturers and from other sources considered to be reliable. Neither Science *nor the writer assumes responsibility for the accuracy of the information. All inquiries concerning items listed should be addressed to the manufacturer. Include the department number in your inquiry.*

■ INFRARED DETECTOR MEASUREMENT CONSOLE (Fig. 1), model ISL302, measures photoconductive, photovoltaic, photoelectromagnetic, and pyroelectric detector characteristics. Also measured are the characteristics of thermistor bolometers and a-c thermocouples. Black-body sensitivity is measured from 350°K to 1000°K as function of frequency, noise band width at a given frequency, and bias voltage. The black body radiates upward for convenient use with cooled cells and liquid refrigerants and can be cooled with water cooling. Black-body temperature is controlled by a platinum-wire thermometer built into the black body and connected to a bridge-type solid-state controller.

Spectral response is measured from 1.0 to 5.5 μ in 0.5 μ steps, with additional points available on request, also as a function of frequency, noise band width at a given frequency, and bias voltage.

Response is measured as a function of intensity by changing black-body apertures or by varying the black-body temperatures for monochromatic measurements. Resistance of photoconductors and bolometers is continuously monitored.

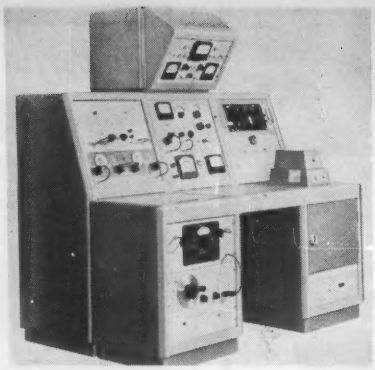


Fig. 1. Infrared detector measurement console.

Noise may be read simultaneously on a wave analyzer and on a meter of adjustable band width. A built-in noise intergrator may be used with either instrument to provide a single-valued, nonambiguous measurement.

Two cell fixtures are provided. One is designed primarily for testing uncooled plate-type cells (up to six at a time); the other will handle most Dewar cooled-cell sizes. Connections are provided for using dry nitrogen to keep the windows of the cooled cells dry.

The console may be preset to given test conditions for use as a production test set. (Infrared Industries Inc., Dept. Sci59, P.O. Box 42, Waltham 54, Mass.)

■ WAVEGUIDE COMPONENTS AND MEASURING EQUIPMENT for D9 double-ridged waveguides, capable of handling a broader band than rectangular waveguide, include adapters, tunable detectors, variable attenuators, directional couplers, impedance meters, slide screw tuners, sliding terminals, high-power terminals, 90-deg axial twists, and waveguide tubings. Components are designed for the 4.75-to-11.0-kMcy/sec band. (Narda Microwave Corp., Dept. Sci28, 118-160 Herricks Rd., Mineola, N.Y.)

■ RADIOMETER for measuring the difference between incoming and outgoing solar radiation consists of a windshielded sensitive element, a gas supply, and an optional heating ring. The sensitive element consists of 250 thermojunctions bounded by two blackened plates. The windshield, formed of two extremely thin plastic hemispheres, is transparent over the full range of wavelengths. Dry nitrogen gas serves to keep the hemispheres inflated and free of internal condensation. The gas container holds enough gas for a year of operation. The heating ring prevents dew formation on the hemispheres. Sensitivity is about 30 mv/g-cal cm^2 min. Internal resistance is about 80 ohms. A calibration certificate is furnished. (Middleton & Co., Dept. Sci29, Tasmania House, 317 Flinders Lane, Melbourne C, Australia)

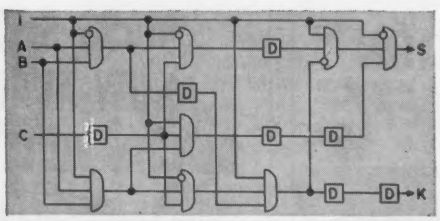
■ DATA TRANSMISSION SYSTEM is used in conjunction with telephone company service to transmit both fixed data from prepunched cards and variable data manually entered on a keyboard. The data received at a central point in the form of punched cards can be fed directly into the manufacturer's automatic data-processing system. At the sending station, the cards are inserted one at a time into a combined reader and keyboard, and the operator moves the card carriage until it strikes a stop. As the carriage returns, data are transmitted at approximately 12 digits per second, up to a maximum of 22 digits, from a single card. A maximum of 79 columns of information can be punched into one output card at the receiving station. (International Business Machines Corp., Dept. Sci24, 112 E. Post Rd., White Plains, N.Y.)

JOSHUA STERN

National Bureau of Standards, Washington, D.C.

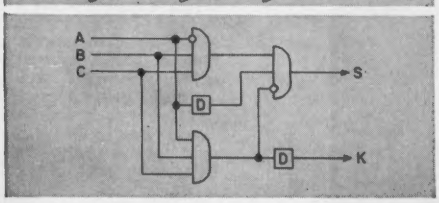
$K=(A+B)\cdot C+A\cdot B$

$S=(A\cdot B\cdot C+\bar{K})\cdot(A+B+C)$



$K=A*B*C$

$S=(\bar{A}*B*C)*A*\bar{K}$



The binary adder stage produced in conventional design above has been reduced and simplified through Majority Logic design to the lower diagram and formula. Discovered and formulated in the Remington Rand Univac Mathematics and Logic Research Department, Majority Decision Logic is a new logical algebra which opens new and interesting possibilities for the reduction in number of logical elements in computer design.

Opportunity for professional advancement has never been greater than it is today at Remington Rand Univac. Working in Univac's *Atmosphere of Achievement*, engineers and scientists are making significant advances in solid state development and computer reliability. The following are several of the positions immediately available.

RESEARCH ENGINEERS. To investigate high speed computer techniques including circuit design, design of logical elements and micrological modules. Applicants should have engineering or science degree with a background in magnetics and solid state devices.

COMPUTER LOGICAL DESIGNERS. To investigate logical concepts, utilizing new electronic components, advanced solid state devices and such Univac developments as the new Majority Decision Logic algebra.

Send a complete resume of your experience and education to: **R. K. PATTERSON,** Dept. JJ-1

Remington Rand Univac

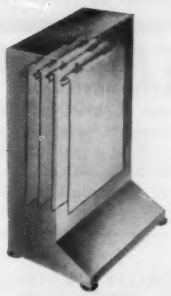
Division of Sperry Rand Corporation • Univac Park • St. Paul 16, Minnesota

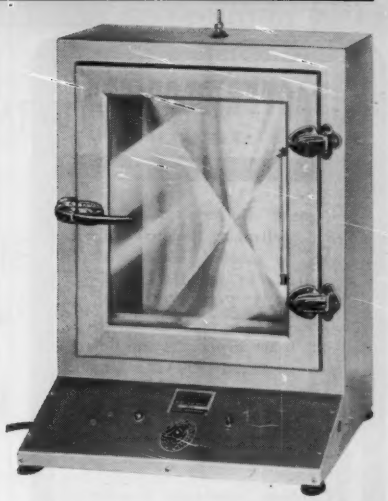
4-SHEET, BENCH-TOP

CHROMATOGRAPHY DRYING OVEN: $360

Holds Four 18¼" x 22½" Sheets.
Provides Full View of Color Development.
Assures Fast, Uniform Drying Action.

Develop 4 chromotograms simultaneously in this compact drying oven. It is fully insulated and thermostatically controlled to quickly reach pre-set temperatures up to 110° C. Uniform drying action is assured by the continuous circulation of air from room through vents in the base. Air and solvent vapors are efficiently evacuated by connecting the oven to a water or motor aspirator accessory. The heating element is concealed in the base and protected from droplets of combustible solvent. Safety glass readily permits temperature reading, and observation of color development without repeated opening of the heavy, metal-reinforced door. The stainless steel oven chamber is corrosion resistant.





OVERALL DIMENSIONS:
26" Wide x 35" High x 15" Deep.

UNCONDITIONAL ONE YEAR WARRANTY

WRITE FOR CATALOG COS-1271

NEW BRUNSWICK SCIENTIFIC CO., INC.
PRECISION LABORATORY APPARATUS
P.O. BOX 606, NEW BRUNSWICK, NEW JERSEY

PERSONNEL PLACEMENT

CLASSIFIED: Positions Wanted. 25c per word, minimum charge $4. Use of Box Number counts as 10 additional words. Payment in advance is required.

COPY for ads must reach SCIENCE 2 weeks before date of issue (Friday of every week).

DISPLAY: Positions Open. Rates listed below—no charge for Box Number. Rates net. No agency commission. No cash discount. Minimum ad: 1 inch. Ads over 1 inch will be billed to the nearest quarter inch. Frequency rate will apply to only repeat of same ad. No copy changes. Payment in advance is required except where satisfactory credit has been established.

Single insertion	$40.00 per inch
4 times in 1 year	38.00 per inch

For PROOFS on display ads, copy must reach SCIENCE 4 weeks before date of issue (Friday of every week).

Replies to blind ads should be addressed as follows:
Box (give number)
Science
1515 Massachusetts Ave., NW
Washington 5, D.C.

POSITIONS WANTED

Physical Chemist, Ph.D. Excellent publication, patent record. Stimulating teacher, productive researcher, administrative experience as academic department head, industrial research director. Seeking challenging department chairmanship or scientific leadership position. Age 38, family. Box 13, SCIENCE. X

Virologist, Ph.D. Tissue culture, genetics, transduction. Desires tumor research with strong biochemical orientation. Box 15, SCIENCE. X

Zoologist, Ph.D., desires teaching-research position. Midwest or Northeast. Box 14, SCIENCE. 2/3

POSITIONS WANTED

(a) **Botany (Mycology) Ph.D.,** bacteriology minor; university biology teaching, 1 year; aeromedical research on cosmic radiation, 3 years; research mycologist for fermentation firm, 2 years; prefers academic or research position. (b) **D.V.M.;** Ph.D. pathology major; histology-cytology minor; university teaching of pathology-parasitology in veterinary schools, 7 years; medical college, 1 year; radioactive pathology research, 3 years; interested in academic, basic, or pharmaceutical research. (Please write for information regarding these and other scientists in all fields; nationwide service.) S1-4 Medical Bureau, Inc., Science Division, Burneice Larson, Chairman, 900 North Michigan Avenue, Chicago. X

Scientist-Translator will translate Japanese technical documents. $30 per 1000 words. Hiroshi Oyama, 307 Decatur, Monterey, Calif. 1/27; 2/3, 10

POSITIONS OPEN

ANATOMIST, HISTOLOGIST,
CYTOLOGIST, HISTOCHEMIST

Ph.D. or equivalent. Research institute, New York. Modern, well-equipped, and staffed laboratory. Opportunity for training in electron microscopy.

Box 12, SCIENCE

PHYSICAL SCIENTISTS
Look for openings at
MELPAR
See our advertisement on page 243

POSITIONS OPEN

(a) **Pharmacologist;** M.D., Ph.D. to direct cardiovascular screening program; requires experienced, able scientist; to $13,000; western pharmaceutical company. (b) **Biochemist;** B.S., M.S. to supervise busy department, 250-bed general hospital; to $7500 for M.S.; Chicago area. (c) **Virologist;** Ph.D. to direct state public health virus laboratory in scenic northern location; minimum $9000; city 20,000. (d) **Bacteriologist;** M.S., Ph.D. to aid in reorganizing laboratory, 300-bed general hospital; $9000; lovely southeastern location. (e) **Neurochemist or Biochemist;** research in degeneration, regeneration central nervous system; faculty appointment possible; outstanding midwestern university medical school. (f) **Bacteriologist;** M.S., Ph.D. experienced clinical bacteriology to head busy section, new 350-bed general hospital; to $8400 for M.S., to $9600 for Ph.D.; West Coast. (g) **Organic Chemist;** young Ph.D. to establish, develop basic research program in polyamino acids; superior facilities, ample funds; faculty appointment if desired in nearby medical school; midcentral government laboratory. (h) **Bacteriologist;** M.S., equivalent in clinical experience to aid board pathologist in laboratory supervision, 250-bed hospital; $7500; Chicago suburb. (i) **Pharmacologist;** Ph.D. experienced investigation autonamic drugs, able do independent research, training, supervise technical help; to $12,000; expanding West Coast company. (j) **Biochemist;** Ph.D. to head department, approved general hospital 250 beds; city 50,000; South; to $12,000. Science Division, **Woodward Medical Bureau,** Ann Woodward, Director, 185 North Wabash, Chicago. X

Research Assistantships in Biochemistry and Physiology at B.A. or M.S. level. Research applicable toward Ph.D.

Heart disease research institute associated with large midwestern university. Initial stipend up to $4800 for 12 months' service. Send complete résumé.

Box 1, SCIENCE

POSITIONS OPEN

BACTERIOLOGISTS

RESEARCH

Creative Bacteriologists will find challenging research projects in medical bacteriology available at ARMOUR RESEARCH FOUNDATION. B.S. or M.S. in Bacteriology and some experience in this field preferred. This is a long established research organization located in a metropolitan area offering cultural and educational advantages.

Excellent employee benefits and liberal vacation policy. Please send resume to E. B. Beck.

ARMOUR RESEARCH FOUNDATION

OF ILLINOIS INSTITUTE OF TECHNOLOGY
10 W. 35th ST. • CHICAGO 16, ILLINOIS

Clinical Chemist—Excellent opportunity for Ph.D. to take charge of small group which develops analytical precedures for measurement of new drugs in biological fluids. Also to supervise assay of body components. *Send resume to Personnel Department,* **Wallace Laboratories,** Cranbury, New Jersey.

(a) **Coccidiosis Research Manager** with parasitology and some biochemistry background to supervise drug testing, product creation, and promotion of active research program for manufacturing firm; around $10,000; Midwest. (b) **Plant Physiologist** for research with plant growth regulator group of large chemical firm; radiotracer techniques helpful; Midwest. (c) **Biochemist** for active department of hospital recently increased to 350 beds in suburban area; $9000–$10,500; East. (d) **Physiologist** for radiation injury, space, and aviation medicine studies; important radiological research program; Pacific Coast. (e) **Editor,** Ph.D. or M.D., to direct group of writers; also **Medical Writers** with B.S. or M.S. degrees; leading pharmaceutical firm; East. (f) **Neuroanatomist** for CNS research and possibly teaching at university medical center; Midwest. (g) **Physiology-Endocrinology Teacher** at graduate level in university; East. (h) **Biologists, Botanists, Zoologists** for field collection and laboratory preparation of specimens for scientific firm; $7000–$8400; also **Department Manager** able to supervise and direct activities, $8000–$9600; Midwest. (i) **Plant Physiologist-Biochemist** for plant growth regulators and germination studies for commercial firm; Midwest. (j) **Head of Virus Laboratory** qualified to assume responsibility for state health department; $8000–$10,680; Northwest. (k) **Psychologist,** Ph.D. or M.A., with extensive rehabilitation experience for university-affiliated hospital; $10,000; East. (l) **Microbiologist/Biochemist** for independent research on chemical and agricultural product development; leading manufacturer offering outstanding opportunities; Midwest. (m) **Medical Director,** Ph.D. in biochemistry or physiology or M.D. to supervise clinical laboratories and conduct research at university hospital; teaching opportunities; Southwest. (Please write for details; also many other positions available through our nationwide service.) S1-4 Medical Bureau, Inc., Science Division, Burneice Larson, Chairman, 900 North Michigan Avenue, Chicago. THE BEST SOURCE FOR THE BEST MEDICAL-SCIENTIFIC POSITIONS. X

POSITIONS OPEN

ORGANIC CHEMIST

(Antibiotic Research)

M.S. in organic chemistry plus experience in natural product isolation, purification & classification.

BIOCHEMIST

M.S. in biochemistry plus industrial experience in natural products area

Send detail resume & salary requirements to PERSONNEL DEPT.

SCHERING CORP.

60 Orange St. Bloomfield, N.J.

RESEARCH ASSISTANT WANTED, for research in physical chemistry of proteins. B.S. or M.S. or equivalent. Salary depends on qualifications. Apply Dr. Arnold Wishnia, Department of Biochemistry, **Dartmouth Medical School,** Hanover, New Hampshire.

UNIQUE CHALLENGE. Openings for physicist, chemist, astronomer, and geologist with graduate degrees, Ph.D. preferred. To instruct at Summer Science Camp. Educational experiment where science is taught in the relaxed surroundings of the outdoors. Small selected enrollment of boys with high aptitude and interest in science. Modern facilities and equipment. Salary open. Director, Adirondack Science Camp, State University College of Education, Plattsburgh, N.Y. 2/10

FELLOWSHIPS

ANNOUNCING UNIVERSITY OF LOUISVILLE PREDOCTORAL FELLOWSHIPS IN BIOCHEMISTRY for 1961–1962. Stipends begin at $1800, tax-free, tuition paid. Dependent and travel allowances. Applications should be submitted *by 1 March.* Write Chairman, Department of Biochemistry, University of Louisville School of Medicine, 101 West Chestnut Street, Louisville 2, Kentucky, for application. 1/27

UNIVERSITY OF FLORIDA

Research Assistantships in Anatomy, Biochemistry, Microbiology, or Physiology Leading to M.S. and Ph.D. Degrees:

FIELDS OF RESEARCH ACTIVITY include experimental embryology, teratology, electron microscopy, venom toxicology, neuroanatomy, neurophysiology, endocrinology, respiration, hemodynamics, immunology, virology, parasitology, bacterial physiology, protein structure and metabolism, nucleic acids, lipids, vitamin synthesis, enzyme mechanisms, biophysical chemistry.

LIBERAL STIPENDS ($255 a month), tuition reduction; high faculty-graduate student ratio; modern new air-conditioned medical school with excellent research facilities; new graduate student housing; pleasant Florida climate.

ADMISSION REQUIREMENTS: Bachelor's degree with high academic achievement, and Graduate Record Examination scores.

For detailed information, write to the chairman of the department of your major interest, UNIVERSITY OF FLORIDA COLLEGE OF MEDICINE, GAINESVILLE, FLORIDA.

The Market Place

BOOKS • SERVICES • SUPPLIES • EQUIPMENT

BOOKS AND MAGAZINES

Your sets and files of scientific journals

are needed by our library and institutional customers. Please send us lists and description of periodical files you are willing to sell at high market prices. Write Dept. A3S, CANNER'S, Inc. Boston 20, Massachusetts

BOOKS AND MAGAZINES

SCIENTIFIC JOURNALS WANTED

Sets, Runs and Volumes bought at top prices. Your wants supplied from our Back Files of over 3,000,000 periodicals. Abrahams Magazine Service N. Y. 3, N. Y.

SUPPLIES AND EQUIPMENT

CAESAREAN-DERIVED
mice
CHARLES RIVER CD-1
Hypophysectomies

THE CHARLES RIVER MOUSE FARMS
Affiliate, The Charles River Breeding Labs
1018 Beacon St., Brookline 46, Mass. RE 4-2000

Now taking orders for:
C3H · AKR · STRONG A · C57BL
(C3H x 101) F1
TEXAS INBRED MICE CO.
305 Almeda-Genoa Rd.; R.F.D. 7, Box 1232-C
Houston 21, Texas

YOU NEED THIS **FREE**
CATALOG FOR YOUR FILES

Serums, antiserums and bloods of all kinds for technicians and tissue culture laboratories. No salesman will call.

COLORADO SERUM CO.
4950 York St. • MAin 3-5373 • Denver 16, Colo.

SWISS MICE

BACTERIOLOGICAL AND GROSS TISSUE STUDY TECHNIQUES USED IN OUR QUALITY CONTROL

HUNTINGDON FARMS, INC.
2548 NORTH 27th ST. PHILA. 32, PA.

1919 - 1961
LaMotte Chemical
Chestertown, Maryland, U.S.A.
Specialists in
Colorimetric Techniques
Reagents-Standards-Comparators
Send for Illustrated
Controls Handbook Dept. H

"From the hand of the veterinarian to research"®

albino rats

CHARLES RIVER CD
(Caesarean derived)
CHARLES RIVER SD
(Sprague-Dawley descendants)
CHARLES RIVER W
(Wistar descendants)

HYPOPHYSECTOMIZED RATS

- Only Charles River CD animals used
- Rigidly controlled environment (same bldg.) birth to surgery.
- High speed surgery by graduate biologists.
- 10 years experience animal surgery.
- Overnight air service from Boston

THE CHARLES RIVER BREEDING LABS
1018 Beacon St., Brookline 46, Mass. RE. 4-2000
Henry L. Foster, D.V.M., President

OUTSTANDING ASSIGNMENTS

for

OUTSTANDING SCIENTISTS

at the

OPERATIONS EVALUATION GROUP

of M. I. T.

Seeking scientists who have the ability and imagination to apply their broad knowledge with *originality* in the field of research, the Operations Evaluation Group of the Massachusetts Institute of Technology offers stimulating career opportunities to scientists with advanced degrees in mathematics and the physical sciences.

For over 18 years, OEG has served as advisor to the Office of Chief of Naval Operations and the operating fleet. Engaged in both conventional operations research and in the solution of complex problems far out of the realm of the ordinary, OEG has the responsibility for conducting research that cuts laterally across many scientific disciplines.

If you have the interest and the creative ability to apply your basic research findings to the solution of problems that are vital to the Navy and the national security, you are invited to write to OEG. Working in a professional atmosphere and exchanging stimulating ideas with colleagues of the same discipline, you will find a rewarding opportunity for increased scientific stature and personal growth.

OPERATIONS EVALUATION GROUP

An Activity of the Massachusetts Institute of Technology

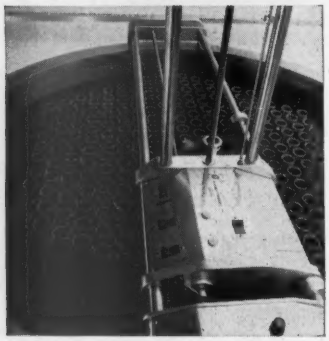
Department D
Washington 25, D. C.

Physicists • Physical Chemists • Mathematicians • Economists • Electronics Engineers

NUCLEAR REVIEWS

from

NUCLEAR-CHICAGO



You are looking into the lattice of the Nuclear-Chicago Model 9000 Subcritical Student Training Reactor. Each tube projecting out of the water contains 5 natural uranium slugs 1" in diameter by 8" long. The center tube holds a neutron source to initiate and maintain a chain reaction.

The Subcritical Assembly is designed so students themselves can change the lattice shape or the source position and study the effect of these changes on neutron distribution, multiplication, and scattering. The parts of the 9000 cannot be arranged in any way to make the device critical. The number of neutrons in the assembly never exceeds 6 to 7 times the neutron source strength. No special shielding is required, no operator licensing, no involved safety program.

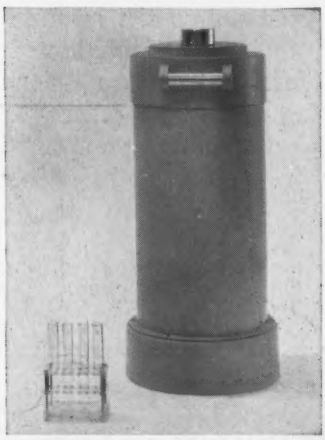
The water moderator allows placement of foils, detectors, and absorbers at any point in the lattice.

An automatic traversing mechanism, like the one shown over the tank, is available to move a detector through the lattice to permit continuous automatic recording of the flux distribution.

The 9000 is in use today in more than 20 colleges and universities. Its low initial cost, simple upkeep, and the fact that its fundamental characteristics are nearly identical with those in a full scale power or research reactor make it an ideal training device. We would be pleased to send you full details.

NEW SCINTILLATION WELL DETECTOR TAKES 20ml SAMPLES

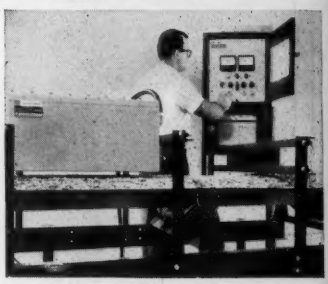
The $2\frac{1}{32}$" diameter well in conventional scintillation well detectors can be frustratingly small. Suppose you have a large volume sample (blood, for instance) that contains a very small amount of radioactivity. You naturally want to count the largest volume possible to increase the accuracy and speed up the measurement. But, that little well puts an end to efficient thoughts like that. The maximum volume you can insert into the well is about 5 ml.



Be frustrated no more! Nuclear-Chicago has designed a new scintillation well detector with a great big 3" diameter crystal with a great big $1\frac{1}{8}$" diameter well. Our new DS-303 accepts samples with volumes up to 20 ml. Now you can cut the amount of labelled material used in your experiment by a factor of four, analyze samples with lower specific activities, speed up counting of routine samples, etc., etc.

We have a new 4-page specification sheet describing the DS-303. Write today for your copy.

MOISTURE-DENSITY MEASUREMENTS ON THE PROCESS LINE



Here is a photograph of the first nuclear gauge ever developed to measure moisture content of bulk materials right on a conveyor belt. It is one of four new process control instruments developed in the past year at Nuclear-Chicago.

The four gauges are designed for measurement and control of *moisture* and *density* of materials on conveyor belts, in bins and hoppers, and in tanks, mixers, and blenders.

Each instrument series consists of three basic parts: a measuring head, an electronic read-out, and a recorder/controller which displays the desired information and controls the measured variable. Density measurements make use of gamma reflection and transmission; moisture measurements are accomplished by neutron reflection methods.

We have an 8-page brochure describing these four new gauges. Ask for the "Qualicon" brochure.

nuclear-chicago
CORPORATION
349 HOWARD AVENUE • DES PLAINES, ILLINOIS